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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1895.

COMMITTEE ON PUBLICATION:

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PHILADELPHIA:
ACADEMY OF NATURAL SCIENCES,
LOGAN SQUARE.
1896.

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ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,
February 6, 1896.

I hereby certify that printed copies of the Proceedings of the Academy for 1895 have been presented at the meetings of the Academy as follows:—

Pages	9 to 24	February 26, 1895.
"	25 to 40	March 19, 1895.
"	41 to 88	April 9, 1895.
"	89 to 152	April 30, 1895.
"	153 to 168	May 14, 1895.
"	169 to 200	May 28, 1895.
"	201 to 210	June 18, 1895.
"	211 to 290	July 2, 1895.
"	291 to 338	August 20, 1895.
"	339 to 370	October 1, 1895
"	371 to 434	November 5, 1895.
"	435 to 514	December 10, 1895.
"	515 to 530	January 7, 1896.
"	531 to 562	February 4, 1896.

EDWARD J. NOLAN,
Recording Secretary.

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OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1895.

JANUARY 1.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Fifteen persons present.

The Council reported that the following Standing Committees had been appointed to serve during the current year:—

ON LIBRARY.—W. S. W. Ruschenberger, M.D., Henry C. Chapman, M.D., Charles P. Perot, George Vaux, Jr., and Dr. C. Newlin Peirce.

ON PUBLICATIONS.—John H. Redfield, Charles E. Smith, Thomas Meehan, George H. Horn, M.D., and Edw. J. Nolan, M.D.

ON INSTRUCTION AND LECTURES.—Charles Morris, Benjamin Sharp, M.D., Samuel G. Dixon, M.D., George A. Rex, M.D., and Uselma C. Smith.

STANDING COMMITTEE OF COUNCIL ON BY-LAWS.—W. S. W. Ruschenberger, M.D., Theodore D. Rand, William Sellers, and Isaac J. Wistar.

JANUARY 8.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Twenty-six persons present.

JANUARY 15.

DR. SAMUEL G. DIXON in the Chair.

Eighty-nine persons present.

A paper entitled "On some new and otherwise interesting Tertiary Mollusca from Texas," by Gilbert D. Harris, was presented for publication.

CHARLES LESTER LEONARD, M.D., made a communication on a new method of studying cell motion as exemplified in the red and white blood corpuscles. (No abstract.)

JANUARY 22.

MR. CHARLES P. PEROT in the Chair.

Twenty-eight persons present.

Papers under the following titles were presented for publication:—

"Notes on Specimens of Pyrenomycetes in the Schweinitz Herbarium of the Academy," by J. B. Ellis.

SOME NEW BEES OF THE GENUS PERDITA.

BY T. D. A. COCKERELL.

In Cresson's catalogue of 1887, there are given thirteen species of *Perdita*, four of which, however, are considered only doubtfully referable to the genus. Of these species 2 are from Col., 2 Cala., 2 Nev., 1 Tex., 1 Col., Nev., 1 Col., Tex., N. Mex., 1 Ga., 1 U. S., 1 N. Am. Lately, Mr. Fox has described three from Lower California. The opinion, which might have been derived from these facts, that the genus is specially characteristic of the arid region, is strengthened by the information given below. Without any special search for the genus, the writer has discovered ten new species in New Mexico during the season of 1894, though one of them had previously been captured by Prof. Townsend.

Mr. Fox, to whom I am very greatly indebted for comparing the types with those of Cresson, has suggested the preparation of a synoptic table. This, however, is deferred for the present, as it is confidently expected that more new species will be found when they are systematically looked for next year.

The specific differences offered by these bees present a very interesting problem to the Darwinian, and it is hoped to dwell at some length on this phase of the subject hereafter. But attention may be called to the peculiar and apparently constant (within narrow limits) markings of the face, which seem to fall under Wallace's class of "recognition marks."

All of the bees now described appear to me to be congeneric in the strictest sense. It has not been thought necessary to mention in each description those characters which run throughout the series; it is assumed that anyone using the descriptions has made himself familiar with the generic type.

With regard to the extent of the pale markings on the face, the New Mexican species of *Perdita* form a series thus:—

Semicrocea + *phymatæ* + *sexmaculata, hyalina, albipennis, albovittata, austini, canina, nitidella* + *foxi, martini, luteola.*

The known distribution of the species in New Mexico is thus:—

(1.) Mesilla valley, about 3,800 ft. above tide.—*Hyalina, albipennis, phymatæ, martini, semicrocea, luteola, nitidella, austini.* =8 spp.

(2.) San Augustine, on east side of Organ Mts.—*Albovittata.* = 1 sp.

(3.) Santa Fé, about 7,000 ft. above tide.—*Sexmaculata, canina, foxi.* =3 spp.

Thus the species of each locality are different.

P. luteola has been described in another paper; it is easily known by its entirely yellow color. The other new species are described herewith. All the types are now in Coll. Amer. Ent. Society.

Perdita phymatæ n. sp. ♀.

About 4½ mm. long: head and thorax shining olive-green, scutellum bluish, metathorax green. Abdomen shining piceous.

Face without pale marks; mandibles brown; antennæ dark brown, last four joints of flagellum pale brown beneath. Crown of head finely punctured. A distinct ridge between antennæ, replaced posteriorly by a groove, which extends to the middle ocellus. A short, shallow groove near and parallel with inner margin of eye.

Thorax very finely punctured, with a few scattered pale hairs. Metathorax with a distinct fovea.

Abdomen piceous, sparsely clothed with pale hairs at tip.

Legs dark brown; wings hyaline, iridescent, venation brown.

Recognized among the species with a dark face, by its dark brown abdomen and legs.

Thorax smooth and very sparsely punctured, except the blue metathorax, which appears rough from extremely minute and close punctures—one should say rugulose rather than punctured.

Abdomen piceous, shiny, apex with pale hairs. Sides of 2d, 3d, and 4th segments with a large, pale yellow spot or blotch. First segment with a deep longitudinal groove extending from its base to a little beyond its middle.

Metathorax with a distinct fovea. A groove near front margin of eye as in *phymatæ*. Legs dark brown, tips of anterior femora, anterior tibiæ beneath, and anterior tarsi, yellow. Wings hyaline, iridescent, venation brown.

Recognized among the species with a dark face, by the piceous abdomen with six yellow spots, and the not entirely brown legs.

Hab.—Santa Fé, N. M., July 25th. (Ckll., 1,647.)

Perdita semicrocea n. sp. ♀.

About 4 mm. long: head and thorax black, with a bronze-green tint in certain lights. Thorax sparsely punctured, vertex of head finely rugulose.

Face wholly dark; antennæ brown, flagellum yellowish beneath. Cheeks behind eyes with white hairs. Metathorax finely rugulose.

Abdomen above orange, deepening in tint towards apex; first segment mostly fuscous, second with an ill-defined fuscous band along its sides and hind margin, third with rudiments of such a band. Under side of abdomen orange.

Legs with coxæ and femora, except at ends, dark. Ends of femora, and whole of tibiæ and tarsi of anterior and middle legs primrose-yellow; corresponding parts of hind legs brownish.

Wings hyaline, veins colorless, stigma pale lemon-yellow. Third discoidal cell distinct.

Recognized among the species with a dark face, by its orange abdomen.

Hab.—Las Cruces, N. M., on yellow (Compositæ) flowers on campus of N. M. Agric. College, beginning of October. (Ckll., 2,500.)

Perdita austini n. sp. ♂.

About 3½ mm. long: head and thorax shining black, head with a slight greenish, metathorax with a bluish tinge. Crown of head very finely granular. White hairs on head and thorax sparse. Tegulæ canary-yellow. Clypeus yellow with a minute black dot on each side; sides of face, in front of eyes, yellow, the yellow extending upward about the length of scape above the level of insertion of antennæ. Scape yellow, funicle and flagellum yellowish below and above brownish below.

Abdomen shining, smooth, with a very few hairs near apex; sepia brown, with broad, yellow bands (not reaching the lateral margin on second segment) occupying the anterior halves of the 2d, 3d, and 4th segments, with another obscurely indicated at hind margin of 4th. The bands are somewhat suffused, not clean cut, at their edges.

Underside of abdomen yellow, brownish towards the tip. Legs yellow and black. Anterior tibiæ and tarsi canary-yellow, femora yellow with a black blotch on inner side, and mostly black without. Middle legs duller, femora mostly black, tibiæ partly so. Hind legs with femora and tibiæ black except their ends, tarsi darkened.

Wings hyaline; stigma almost, veins quite, colorless. Third discoidal absent.

Recognized among the species with partly yellow face by the yellow extending above level of insertion of antennæ along the margin of the eyes but not in the median line, and by the small size and suffused tints.

Hab.—Las Cruces, N. M., on campus of N. M. Agric. Coll., September. (Ckll., 2,398.)

Mr. Fox writes of *austini* that it is "near *zebrata* but differs by the more slender legs, 2d submarginal cell narrower at the top; the head retreats more rapidly behind the eyes. It differs principally from

Abdomen with about equally broad bands of pale yellow and piceous, the piceous bands being at base of 1st, at junction of 1st and 2d, at distal margin of 2d and 3d, at junction of 4th and 5th, and at distal margin of 5th segment.

Legs primrose-yellow, posterior tibiæ and femora more or less fuscous above. Wings hyaline, venation extremely pale; outer margin of 3d discoidal very faint.

Abdomen beneath entirely yellow, tip tinged with orange.

Recognized among the species with partly yellow face, by the yellow extending upwards to the level of the anterior ocellus, and the almost entirely yellow legs. The face is practically all yellow.

Hab.—Las Cruces, N. M., on the College Farm, April 26th. (Ckll., 731.)

I have ventured to name this and the next preceding after my two little sons, the elder of whom has gone to the undiscovered country.

Perdita albovittata n. sp. ♀.

About 5½ mm. long; head and thorax shining dark indigo-blue, with the white hairs more prominent than in *sexmaculata*, forming quite a conspicuous white pubescence on cheeks and face. Antennæ dark brown, paler, but still dark, towards their ends. Mandibles brownish. Clypeus and a large patch on each side of it ivory-white; clypeus with a blackish mark rather in the form of a horse-shoe, but very faint medially and broadened laterally.

Head rather sparsely punctate. Thorax very sparsely punctate. Metathorax shiny, not roughened as in *sexmaculata*.

Abdomen piceous, with dense, rather coarse white hairs at tip. 1st segment with a deep groove, extending somewhat beyond its middle. 2d and 3d segments each with a broad yellowish-white band, 4th with two bands. Band on 2d segment narrowly interrupted medially; it is situated along the upper margin of the segment, except at sides, where it bends hindward. Band on 3d segment similar, but only constricted, not interrupted, medially. 1st band on 4th segment similar, but only notched medially on its hind margin, broader, and evanescent at sides. 2d band on 4th segment placed along its hind margin, straight, and evanescent at sides; it represents the band of 5th segment pushed forward.

Underside of abdomen piceous, with pale marks at sides, resembling the upper side of abdomen of *sexmaculata* considerably.

Legs black. Wings hyaline with a milky tint, iridescent. Venation pale brown.

Recognized among the species with partly white face, by its denser hairs on head and thorax, white bands on abdomen, and black legs.

Hab.—San Augustine, N. M., August 29th. (Ckll., 2,270.) Another example, from the same locality and taken on the same day (Ckll., 2,277, a ♂), differs a little, having the dark marks on clypeus reduced, mesothorax above very dark, slightly greenish, not blue (metathorax and pleura blue), band of 2d segment of abdomen constricted, not interrupted medially.

Mr. Fox writes: "*albovittata* also very distinct by dark legs, immaculate pronotum and long marginal cell."

Perdita nitidella n. sp. ♂.

About 4 mm. long; head and thorax greenish-blue. Face (including clypeus) up to level of insertion of antennæ bright yellow, furthermore, the yellow extends as much beyond the insertion of the antennæ as the length of the scape, but is divided by two incursions of the dark blue, which descend to the bases of the antennæ, their sides forming right angles thereat. Antennæ yellow, funicle, flagellum, and tip of scape more or less dark brown above.

Head and thorax finely rugulose. Borders of prothorax, and tegulæ, yellow. Abdomen shiny, yellow, becoming darker towards the tip, with dark brown bands. These bands are one at base of 1st segment and one at its distal border, these two connected by a longitudinal median line; a broad one at distal border of 2d seg-

College, September. (Ckll., 2,405.) Another specimen had previously been taken at Las Cruces, by Prof. C. H. T. Townsend.

Mr. Fox writes: "*nitidella* is new, unless the ♂ of some known species, which, however, I think unlikely." I do not myself entertain any serious doubts as to the validity of the species.

Perdita canina n. sp. ♂.

About 5 mm. long; head and thorax dark metallic-blue, the white pubescence moderately abundant. Crown of head minutely granular, with punctures interspersed, showing that the granulations do not represent minute punctures of the ordinary sort.

Clypeus yellowish-white, this color extending upwards to level of antennæ and there abruptly truncate, with a slight indentation in the middle. On each side this is touched by a heart-shaped spot situated beneath the antennæ, the whole so placed as to suggest the head of a hound, with drooping ears, seen from behind. A minute, black dot on each side of clypeus, as in *austini*. Besides these markings a narrowing band of yellow borders the eyes in front, coming to a point a little above the level of the antennæ. Antennæ yellow beneath and black above.

Thorax shiny, sparsely punctured, tegulæ pale yellow.

Abdomen yellow and dark sepia-brown; 1st segment brown; 2d and 3d segments, with the disc broadly yellow, margined with brown, this margin not covering the sides, which are yellow at the angles. 4th segment yellow with its upper margin brown, the brown extending hindward at the sides to about the middle of the segment. Just below this brown margin, medially, is a minute dot of brown. Hind margin of 4th segment narrowly brown, with a squarish brown mark on each side about half-way between lateral margin and centre. 5th segment yellow, very narrowly margined with brown above at centre, and with a brown spot on each side near lateral margin, and near hind margin a pair of brown marks representing the squarish marks of previous segment. Remaining segments yellow. Abdomen shiny, obscurely punctate.

Legs yellow marked with black; anterior femur and tibia each with a black patch behind; middle femur with an oblique black patch behind, middle tibia mostly black, middle tarsus pale brownish. Hind femur with a large elongated black patch above, hind tibia and tarsus blackish.

Wings hyaline, veins dark brown, stigma margined with brown, 3d discoidal very weak.

Abdomen beneath yellow, the anterior margins of the segments narrowly black.

Hab.—Santa Fé, N. M., July 19th. (Ckll., 1,572 and 1,571.)

Mr. Fox writes: "*canina* may be the ♂ of *zebrata*, although I had previously referred two ♂ specimens, different from yours, to that species."

There was taken, however, at Santa Fé (Ckll., 1,270, July 5th) a specimen of which Mr. Fox writes: "No. 1,270 I had named as *P. albipennis*, but I now find it differs from that species and is perhaps the ♀ of *canina*."

This example differs principally from *canina* (♂) by the face markings being white; the clypeus not entirely pale, but with the pale color terminating on its upper half in three projections; the yellowish above the clypeus represented by a pair of oval, white marks; the dog's-ear-like marks absent; the 1st segment of abdomen with a narrow interrupted band, the bands on the other segments continuous in the middle; antennæ darker; size larger.

I think this is a distinct (and new) species, but it may be wiser to leave it unnamed until its relationship with *canina* can be made clearer. In *P. albipennis*, the sexes differ very much in the coloration of the abdomen, but I find the face markings practically the same in ♂ and ♀. Hence it seems likely that the dog's-head markings are characteristic of *canina* in either sex. In its face marktremity, the termination of this band being about (or hardly) as far above the level of the insertion of the antennæ as the length of the scape. Cheeks yellow. Antennæ dull chrome-yellow, funicle and flagellum blackened above.

Thorax, seen from above, much the shape of a Goodale pear (see Downing), metathorax abruptly truncate and rapidly descending, rugulose.

Lateral margin of prothorax yellow. Tegulæ pale testaceous. Legs pale rufous, or one might say brownish-orange.

Wings hyaline, beautifully iridescent, veins and stigma distinct, dark (sepia) brown. The recurrent and transverso-cubital nervures more or less broken by hyaline spots. 3d discoidal distinct. Marginal about as long as stigma.

Abdomen pitch-black, shiny, hind margins of 3d and 4th segments obscurely brownish.

Recognized by its black abdomen and orange-rufous legs; nearest to *nitidella* in its face markings, but still quite distinct.

Hab.—Santa Fé, N. M., June 25th. (Ckll., 1,096.)

Mr. Fox remarks that this is "very distinct and new." I owe to him the opportunity of describing it, as I had sent it to him before I became interested in the genus, and he kindly returned it that it might be included in the present paper.

NOTES ON SOME SPECIMENS OF PYRENOMYCETES IN THE SCHWEINITZ HERBARIUM OF THE ACADEMY.

BY J. B. ELLIS.

Some time during the past year (1894) there was found in the Herbarium of the Academy of Natural Sciences of Philadelphia, a package that had lain unnoticed for many years. The package was found to contain many of the missing specimens mentioned in the preface to The North Am. Pyrenomycetes. These specimens are evidently authentic and reliable, the writing on the papers in which they are wrapped being in Schweinitz's own hand, with the abbreviation L. v. S.[1] after the names of the species described by him. In only a few cases are the habitats given, but almost all are marked as collected either at Bethlehem, Pa., or Salem, N. C. They are all very small—many of them old and without fruit.

From a careful examination of the specimens the following notes were made to enable one to recognize some of the Schweinitzian species that have hitherto been only imperfectly understood. Dr. Karl Starbäck in his "Studier i Elias Fries Svamparherbarium:" Bihang till K. Svenska Vet. Akad. Handl., Band 19, Afd. III, No. 2, 1894, has also examined some of the specimens noted and his observations agree with those here recorded:—

Lasiosphæria setosa (Schw.).

Sphæria setosa Schw., Syn. N. Am., 1,533.

Perithecia gregarious, superficial, ovate-conical, about ¾ mm. high and ½ mm. broad, clothed except the black, entire or subsulcate, obtuse ostiolum, with tubèrculiform tufts of matted hairs among which arise other, darker, longer hairs. Asci elongated, narrowed above, short-stipitate, paraphysate, 8-spored, 100–120 x 12–15μ. Sporidia biseriate, cylindrical, hyaline, nucleate, curved near the lower end, 45–55 x 4–5μ; about the same as in *L. hirsuta.*

On rotten wood, Bethlehem, Pa. (Schw.).

Lasiosphæria emergens (Schw.).

Sphæria emergens Schw., Syn. N. Am., 1,534.

Mycelium of brown, branching threads septate and undulate, bearing terminally (and laterally)? yellowish-brown, globose conidia 12–15μ diam. with coarsely granular contents. Sporidia nearly straight, cylindrical, hyaline, 28–32 x 4μ, apparently becoming 3-septate.

Differs from *L. Rhacodium* in its ovate-conical perithecia.

Chætosphæria squamulata (Schw.).

Sphæria squamata Schw., Syn. N. Am., 1,538.
Melanomma squamulata E. & E., N. A. Pyr., p. 184.
Sphæria squamata in Herb. Schw.
Chætosphæria squamulata Starbäck, Studier i Elias Fr. Svamp. Herb., p. 31.

When the N. A. P. was published we had not seen an authentic spec. of this species, which is accurately described by Starbäck, l.c., the description there given applying perfectly to the spec. in Herb. Schw. This spec., however, is labeled *Sphæria* "*squamata*" L. v. S., instead of *squamulata* as given in Syn. N. Am. with the added note "olim *S. fuscospora.*"

Herpotrichia diffusa (Schw.) var. **rhodomphala** B. & C.

Sphæria diffusa Schw., Syn. N. Am., 1,502.
Sphæria rhodomphala Berk. Hook., Lond. Journ. Bot., IV, p. 212. *Sph. tristis* in Herb. Schw.
Amphisphæria subiculosa E. & E., Journ. Mycol., II, p. 103.
Neopeckia diffusa Starbäck, Stud. i Elias Fries Svamp. Herb., Vet. Akad Handl., 1894.
Didymotrichia diffusa Berlese, in the Proc. of the International Bot. Congress, 1892.

The specc. distributed in Ell. & Evrht's N. A. F., 2,130, differ from the Schweinitzian spec. in having the perithecia smaller (about ¼ mm.), and less crowded, and in their rather smaller, less distinctly constricted sporidia. These differences, however, seem hardly to be of specific value, all the other characters being the same, and it seems better to put the N. A. F. specc. as a mere var. of that in Herb. Schw., *viz.*, var. *rhodomphala* Berk. *Sphæria rhodomphala* Berk., l. c.

Rosellinia araneosa (Pers.).
Sphæria araneosa Pers., Icon. et descr., 1, p. 24, tab. VII, fig. 6, *a–h*.
Rosellinia araneosa Sacc., Syll., I, p. 259.

Perithecia crowded in elongated groups ½–1 cm. long, 3–4 mm. wide, globose, papillate, ¾ mm. diam. Sporidia (free spores) inequilaterally elliptical, brown, continuous, 7–9 x 5–6μ.

Has the external aspect of *Rosellinia medullaris* (Wallr.), from which it differs in its rather smaller perithecia and very different sporidia.

Rosellinia thelena Fr., var. **terrestris**.
Sphæria terrestris Schw. in Herb.

Perithecia depressed-globose, grayish-brown, smooth, with a distinct papilliform ostiolum, gregarious, or crowded, about ¾ mm. diam., connected at base by a thin, brown subiculum of matted hairs. Asci (p. sp.) 130 x 6μ, paraphysate, 8-spored. Sporidia overlapping-uniseriate, oblong-fusoid, deep brown, continuous, straight, 22–25 x 5–7μ, with a straight, hyaline, mucronate appendage at each end.

On the ground, New York State (Schw.).

Melanomma exile (Schw.).
Sphæria exile, Schw. in Herb. Schw.

Perithecia scattered, erumpent-superficial, black, minute, 120–150μ diam., finally slightly collapsed. Ostiolum conic-papilliform. The asci could not be made out but sporidia (free spores) were globose, with a papilliform ostiolum soon perforated, seated on a red subiculum and clothed with a thin, dirty rose-colored, pulveraceo-tomentose coat. The mycelium is very thin and scanty and the wood is stained red in the part occupied by the perithecia. The substance of the perithecia themselves also has a reddish tint. Asci cylindrical, p. sp. 68–75 x 8μ, short-stipitate, 8-spored, paraphysate. Sporidia uniseriate, elliptical or subglobose, opake, 8–12 x 5–7μ.

Rosellinia imposita Schw.
Sphæria imposita Schw., Syn. N. Am., 1,503.

This differs from *R. aquila* only in the scanty subiculum.

Sporidia oblong, continuous, brown, 18–24 x 6–8μ.

Ceratostomella investita (Schw.).
Sphæria investita Schw., in Herb. Fries.
Sphæria investita in Schw. Syn. N. Am., 1,621?
Sphæria vestita Schw., in Herb. Schw.
Ceratostomella investita Starbäck, l. c.

Perithecia gregarious, immersed, or partly superficial, 400μ diam., beset around the lower part with slender, black, septate hairs 80–120 x 3μ, and pubescent with shorter, finer hairs above. Ostiola cylindrical, 1 mm. or more long, erumpent through a felt-like brownish-yellow tomentum overspreading the surface of the wood.

Asci cylindrical, 60–65 x 6–7μ, with a short stipe, p. sp. 50–60μ long. Paraphyses none. Sporidia uniseriate, or subbiseriate above, oblong-elliptical, 6–8 x 3½μ, hyaline, 2-nucleate.

There can be no doubt that this is the same as the spec. examined by Starbäck, in Herb. Fries, but it does not agree entirely with the diagnosis given by Schweinitz, as the ostiola are not "sulcate-tuberculose," nor are they "thickened above." The spec. from Herb. Schw. was labeled "*Sphæria vestita*" L. v. S., and was on rotten wood, Bethlehem Pa., "*vestita*" being apparently a lapsus calami for *investita*.

Amphisphæria papilla (Schw.).
Sphæria papilla Schw., Syn. Car., 159.
Melanopsamma papilla (Schw.), N. A. Pyr., p. 178.

Perithecia conic-hemispherical, with the base slightly sunk in the wood, ¾–1 mm. diam. with a distinct conic-papilliform ostiolum. Asci cylindrical, short-stipitate, paraphysate, p. sp. 100–120 x 12–15μ. Sporidia overlapping-uniseriate, fusoid-oblong, subinequilateral, brown, uniseptate, slightly constricted, 25–32 x 8–12μ.

On rotten wood, Bethlehem, Pa.

This has the outward appearance of the specc. on white oak bark, mentioned in N. A. Pyr., p. 178, but the asci and sporidia are smaller, and the latter are brown. Notwithstanding these discrepancies, the Newfield specc. are no doubt referable to *Sphæria papilla* Schw.

Trematosphæria mastoidea (Fr.).

Starbäck, l. c., gives as syn. of this species: *Sphæria albicans* Schw., Syn. Car., 176, and *Sphæria obtecta*, Schw., Syn. Car., 206.

The spec. in Herb. Schw. is entirely without fruit.

Sphæria denudans Schw., Syn. N. Am., 1,625, is apparently a *Trematosphæria*, but the spec. in Herb. Schw. is old, and the perithecia mostly broken down. A few free spores were seen, oblong, dark brown, 3-septate, 20–22 x 7–8μ.

Trematosphæria applanata (Fr.).

Sphæria applanata Fr., S. M., II, p. 463 (in part at least).
Sphæria applanata Oudem., Anwinst. Myc. Neder., 1875–1876, p. 11.
Sphæria Aspergrenii Fr., in Herb. Schw.
Trematosphæria applanata Sacc., Syll., II, p. 120.

From the spec. in Herb. Schw. the following diagnosis has been made:—

Perithecia scattered, erumpent-superficial, depressed-hemispherical, 170–200μ diam., becoming more or less collapsed above, with a papilliform ostiolum. Asci oblong-cylindrical, short-stipitate, p. sp. 75–80 x 18–22μ, paraphysate, 8-spored. Sporidia obliquely uniseriate, or biseriate, clavate-oblong, 4–5- (mostly 4-) septate, and finally constricted at the septa, 24–30 x 7–9μ, surrounded with

Trematosphæria confertula (Schw.).

Sphæria confertula Schw., Syn. N. Am., 1,508.

Perithecia densely crowded, seated on a felt-like brown subiculum and clothed below with straight, septate, bristle-like brown hairs, globose, about ⅓ mm. diam., finally collapsing to cup-shaped. Asci clavate-cylindrical, stipitate, paraphysate, 8-spored, p. sp. 60–67 x 12μ. Sporidia biseriate, oblong, slightly curved, hyaline and uniseptate at first, becoming brown and 3-septate but not constricted, 18–22 x 6–7μ

Whether this is the same as *Amphisperia conferta* Schw., in N. A. P., p. 206, is doubtful. The spec. referred to in Syn. Car. was on bark of *Sassafras*, and is described as having the perithecia depressed at the apex, while in the Bethlehem spec. here described, they are deeply collapsed. Dr. Cooke who examined a spec. from Carolina, in Herb. Berk., found the sporidia uniseptate, 12 x 4μ. Probably the Carolina spec. is a different thing from the Bethlehem spec., though Schweinitz in Syn. N. Am. considers them the same.

On rotten wood, Bethlehem, Pa. (Schw.).

Trematosphæria Schweinitzii E. & E.

Perithecia gregarious, semiemergent or erumpent-superficial, ¼–⅓ mm. diam., ovate-conical, gradually attenuated above into the conical or short-cylindrical ostiolum, or when erumpent, depressed-globose with tuberculo-papilliform ostiolum, roughish and brownish-black. Asci cylindrical, stipitate, paraphysate, p. sp. about 90 x 8–10μ. Sporidia overlapping-uniseriate, fusoid, brown, 3-septate and constricted at the middle septum, the end cells attenuated to an obtuse point and a little paler, 19–22 x 5–6μ.

On dead canes of *Rubus*, Bethlehem, Pa., Schw. (in Herb.), under the name of *Sphæria rostellata* Fr.

Teichospora tenacella (Fr.).

Sphæria tenacella Fr., S. M., II, p. 492.

Perithecia subseriate, semierumpent through longitudinal cracks in the epidermis, subglobose, smooth, about ⅓ mm. diam., finally collapsing above. Asci not seen. Sporidia oblong or oblong-elliptical, brown, the end cells paler, 3–5 (mostly 3-) septate, with a more or less continuous longitudinal septum, 20–26 x 10–11μ. In the oblong sporidia there are mostly only the three transverse septa with constrictions at each septum, but in the oblong-elliptical sporidia, which make up the greater number, there is a single longitudinal septum and no constrictions.

On small, dead limbs, Bethlehem, Pa., Schw.

Amphisphæria nobilis (Schw.).

Sphæria nobilis Schw. in Herb. Schw.

Perithecia superficial, ovate-globose, black, 350–400μ diam., glabrous, with an acutely papilliform ostiolum. Asci clavate-cylindrical, short-stipitate, paraphysate, 75–80 x 12–15μ, 8-spored. Sporidia crowded-biseriate, oblong-fusoid, slightly curved, obtuse, brown, uniseptate, scarcely constricted, each cell with a large nucleus, 18–22 x 6–7μ.

The base of the perithecia is only slightly sunk in the surface of the wood, but there is nothing to indicate that they ever become movable.

On rotten wood, Salem, N. C. (Schw.).

Lophiostoma tingens (Schw.).

Sphæria tingens Schw., Syn. N. Am., 1,591.

Perithecia entirely buried in the wood, ovate-globose, about ¾ mm. diam., subcompressed, neck flattened with the obtusely conical, subtubercular, stout; ostiolum erumpent and only slightly compressed. Asci clavate-cylindrical, short-stipitate, 110–120 x 15–18μ, 8-spored, with abundant, filiform paraphyses. Sporidia biseriate or oblique, broad-fusoid, hyaline, becoming brownish, 4–6- (mostly 5-) septate, 22–30 x 6–7μ.

On decorticated, weather-beaten wood of Sassafras, Bethlehem, Pa.

Cryptosphæria pætula (Fr.).

Sphæria pætula Fr., S. M., II, p. 483.
Sphæria secreta C. & E., Grev., V, p. 94.
Crytosphæria secreta (C. & E.) Sacc., Syll., No. 688, and Ell. & Evrht., N. A. Pyr., p. 514.

The Schweinitzian spec. shows no asci, but the perithecia, habit, and sporidia are the same as in *Sphæria secreta*, C. & E., leaving no doubt that the latter is the same as *Sphæria pætula* (Fr.) if, as seems probable, the spec. in Herb. Schw. is reliable.

Pseudovalsa occulta (Schw.)

Sphæria occulta in Herb. Schw.

Stroma cortical, orbicular, not circumscribed, 2–3 mm. diam., convex. Perithecia 1–5 in a stroma, ¾–1 mm. diam., globose, their bases slightly sunk in the surface of the wood, ascigerous nucleus light colored. Ostiola obscure, erumpent in a small black disk, which is orbicular or narrowly and transversely elliptical, slightly raising and perforating the epidermis and closely embraced by it. Asci broad clavate-cylindrical, 180–210 x 20–30μ (including the very short stipe, 8-spored, with filiform, sparingly branched or mostly simple paraphyses. Sporidia biseriate, broad-fusoid-oblong, obtuse, 3-septate, 45–62 x 13–16μ, hyaline, becoming brownish.

Differs from *P. malbrancheana* Sacc. in its 8-spored asci and only 3-septate sporidia not hyaline at the ends.

Diatrypella obscurata (Schw.).

Sphæria obscurata Schw. (in Herb.).

Perithecia large (¾ mm.), either lying singly, or 2–6 together in a subcuticular stroma 2–6 mm. diam., black and rough outside, white within, blackening the surface of the wood which is also deeply penetrated by a dark, circumscribing line enclosing several stromata. Asci clavate, 75–80 x 12–15μ, p. sp. about 50μ, long, polysporous. Sporidia irregularly crowded, yellow in the mass, hyaline when seen singly, allantoid, moderately curved, with a nucleus near each end, 5–6 x 1¼μ.

On limbs of some shrub or tree, Bethlehem, Pa., Schw.

Hypoxylon annulatum (Schw.) Mont.

Sphæria annulata Schw. in litteris ad Fries. See Fr. Elench., II, p. 64.
Sphæria annulata B. *depressa* Fr., l. c.
Sphæria truncata Schw. in litt. Fr. Elech., l. c., but (sec. Fries) not *Sphæria truncata* Schw. in Syn. Car.
Hypoxylon annulatum Mont., Syll. Crypt., p. 213.

The spec. of *Sphæria truncata* Schw. from Herb. Schw. agrees perfectly with specc. of *Hypoxylon annulatum* distributed in Ell. & Evrht's N. Am. Fungi, 2d Series, 2,353.

Phoma pyrina (Schw.).

Sphæria pyrina Schw. in Herb. Schw.

Perithecia thickly scattered, subepidermal, small (¼ mm.), finally rupturing the epidermis but not prominent. Sporules hyaline, compressed; when viewed in front, ovate, 5–6 x 3μ; seen edgewise, allantoid, 5–6 x 1–1½μ.

On dead apple tree limbs, Bethlehem, Pa. (Schw.).

Phoma Samararum Desm.

Sphæria Samaræ Schw., Syn. N. Am., 1,703.

On Samaræ of *Fraxinus*, Bethlehem, Pa. (Schw.).

Starbäck (l. c.) also finds a *Sphæropsis* on the spec. of *Sphæria Samaræ*, in Herb. Fries.

Phoma tageticola (Schw.).

Sphæria tageticola Schw., Syn. N. Am., 1,729.
Phoma herbarum, var. *tageticola* Starbäck, l. c., p. 52.

Perithecia aggregated or solitary, papillate, white inside, globose-depressed. Sporules cylindrical, hyaline, 2–3-nucleate, obtuse, 8–12 x 2–3μ.

Vermicularia Cacti (Schw.).

Sphæria Cacti Schw., Syn. Car., 227.
Vermicularia Cacti (Schw.). Starbäck, l. c., p. 63, with a full description.

The specc. in Herb. Schw. are evidently a *Vermicularia*, but too poorly developed to allow of an accurate diagnosis.

Sphæropsis Taxi (Schw.).

Sphæropsis Sumachi (Schw.) C. & E.

Sphæria Sumachi Schw., Syn. N. Am., 1,425.
Sphæria subsolitaria Schw. in Herb. Schw.
Sphæropsis Sumachi C. & E., Grev., V, p. 31, pl. 75, fig. 11.

These are all pycnidia of *Sphæria ambigua* Schw., Syn. N. Am., 1,492 = *Botryosphæria fuliginosa* (M. & N.). See N. A. Pyr., p. 546.

Sphæropsis Ruborum (Schw.).

Sphæria Ruborum Schw., Syn. N. Am., 1,677.
Sphæropsis rubicola C. & E., Grev., VI, p. 2, pl. 95, fig. 2.

The spec. in Herb. Schw. affords no spores; but Starbäck (l. c.) finds specc. of *Sphæria Ruborum* Schw. in Herb. Fr., which are identical with specc. of *Sphæropsis rubicola* C. & E.

Sphæropsis pericarpii (Schw.).

Sphæria pericarpii Schw., Syn. N. Am., 1,590.
Sphæropsis pericarpii Pk. 25th Rep., p. 85.
Sphæropsis Caryæ C. & E., Grev., V, p. 52?
Sphæria involucri Schw. in Herb. Schw.?

On pericarp of hickory nuts, Bethlehem, Pa. (Schw.), N. York State (Peck), New Jersey (Ellis).

In the Schweinitzian spec. of *S. involucri*, some of the sporules are uniseptate, but the greater number are without septa. The sporules in all the above quoted specc. are about 20–25 x 10–12μ.

Discosia placentula (Schw.).

Sphæria placentula Schw. in Herb.

Discoid, orbicular, about ½ mm. diam., black, somewhat wrinkled, umbilicate-depressed in the center, the papilliform ostiolum seated in the center of the depression. Sporules oblong-cylindrical, slightly curved, hyaline, faintly 4-nucleate, 10–13 x 1½–2μ, with an oblique, hyaline, slender bristle at each end about as long as the spore itself.

On some decaying leaf (Tilia)?, Bethlehem, Pa. (Schweinitz.).

Sphæria fibriseda Schw., Syn. N. Am., 1,542.

Perithecia globose or oftener suboblong, 55–75μ diam., very abundant but entirely sterile—no asci or sporidia. Apparently an abortive *Nectria*.

Sphæria viridiatra Schw., Syn. N. Am., 1,537.

The perithecia are immature, but to all outward appearance, this is, as stated in N. A. P., p. 748, *Calonectria chlorinella* Cke.

Sphæria palina Fr. (in Herb. Schw.).
Cytispora exasperans E. & E. in Proc. Acad. Nat. Sci. Phil., Nov. 1884, p. 360, is the same as this.

Sec Starbäck, l. c., p. 59, *Sphæria palina* Fr., belongs to the Friesian genus *Glutinium*.

"Perithecia loosely gregarious, cespitose or subconfluent, subglobose at first, then erumpent-superficial, depressed-cylindrical, or almost thick-discoid, with a large, irregular opening; almost rimose-dehiscent, black, about 150μ high and 250μ broad. Sporules cylindrical, straight, hyaline, 7–10 x 2–2½μ, borne terminally or laterally on filiform basidia of various length."

From the above diagnosis it is plain that the *Sphæria palina* in Herb. Schw. is quite distinct from *Sphæria palina* Fr.

Sphæria Gossypii Schw., Syn. Car., 207.

This is an obscure thing. The inner membrane of the cotton boll is wrinkled or roughened in drying so as to give the appearance of minute perithecia, but there is no fruit or even any real perithecia.

Sphæria fraxicola Schw., Syn. N. Am., 1,787.

The spec. has the aspect of *Sphærella maculiformis*, but is entirely sterile.

Sphæria vilis Fr., in Herb. Schw., is *Ohleria modesta*, Fckl., and quite different from *Sphæria vilis*, Fr., in Fr. S. M., II, p. 466. See Ell. & Evrht., N. A. Pyr., p. 217.

Sphæria stricta Pers., Syn., p. 59.

There are two specc.; one with scattered, buried perithecia (*Ceratostoma cirrhosa* (Pers.), the other with clustered, superficial perithecia. The latter may be *Ceratostomella stricta*, but the perithecia are empty and broken, only the lower part remaining.

The following species as represented in Herb. Schw. are undeterminable; either old, immature, or sterile, viz:—

Sphæria aggregata Schw.
" *albocrustata* "
" *andromedicola* "
" *apertiuscula* "
" *Asclepiadis* "
" *boleticola* "
" *castanicola* "
" *cinerascens* "
" *circumscissa* "
" *Corni* "
" *Cucurbitacearum* "
" *Daphnidis* "
" *herbicola* "
" *incanescens* "
" *Juglandis* "

Sphæria lilacina Schw.
" *moricola* "
" *navicularis* "
" *nigrella* "
" *nigrocincta* "
" *obsita* "
" *Panici* "
" *pruina* "
" *punctans* "
" *rudis* "
" *scapincola* "
" *seriata* "
" *subbullans* "
" *subseriata* "

DESCRIPTIONS OF NEW MAMMALS FROM FLORIDA AND SOUTHERN CALIFORNIA.

BY SAMUEL N. RHOADS.

1. **Atalapha borealis seminola** subsp. nov. Type, ad. ♂, No. 649, Col. of S. N. Rhoads, Tarpon Springs, Hernando Co., Florida. Col. by W. S. Dickinson, July 12, 1892.

Description.—Somewhat smaller than *A. borealis* with a relatively larger foot. Body colors above, from crown to tip of tail, including ears, feet, interfemoral membrane and hairy spaces at upper base of pollex and on proximal upper margins of the fifth metacarpal, uniform, cinnamon-brown, sparingly and minutely tipped with ash on the cervical, dorsal, and anterior interfemoral regions. Forehead, cheeks, and chin, yellowish-brown. Throat, neck, and breast, like back but more strongly tipped with ash. Abdomen like chin; hairy lower surfaces of wings cinnamon along sides of body, fading to orange-brown at the bases of metacarpals. Ear membranes dark brown, postbrachial membranes but slightly darker than in *borealis*, the antebrachial decidedly darker; interfemoral membrane nearly naked above on the distal third, the inferior hairy space at root of tail being less extensive than in *borealis*. Basal half of body hairs parison. Since then Mr. Chapman[1] has not only stated that the Florida specimens examined by him are darker than typical *borealis* but that *pfeifferi* differs from *borealis* in its "brighter" colors. This statement removes the last objection to recognizing the Florida Red Bat as a well-marked and hitherto undefined subspecies of *Atalapha borealis.*

2. **Peromyscus insignis** sp. nov. Type, ad. ♂, No. 1,308, Col. of S. N. Rhoads, Dulzura, San Diego Co., California. Col. by Charles Marsh, Aug. 21, 1893.

Description.—Size very large, ears, feet, and whiskers of maximum size, tail very long, considerably exceeding length of head and body. Colors above light brownish-gray, strongly shaded with coarse, black hairs, grayest on head, blackest on back, brownest on rump and thighs; sides, from whiskers to hams, including upper half of forearm, washed with fawn, becoming ochraceous on forearm and along division of upper and lower body colors; under surfaces, including pes, manus, wrist, and lower (inner) surfaces of limbs and lower half of tail, a uniform, clear, grayish-white, the hair plumbeous basally; whiskers black; upper half of tail, sooty; ears nearly naked, the membrane within and without of a smoke-brown hue and equally clothed on both sides with sparse, minute, grayish hairs.

Skull—Small for the size of animal, rostrum short and slender; nasals short, their bases distinctly anterior to the posterior extension of the premaxillaries, the latter reaching behind anterior plane of orbits; frontals rounded posteriorly; audital bullæ inflated; incisive foramina short, wide at base, and much narrowed anteriorly.

Measurements (of type in millimeters).—Total length, 233; tail vertebræ, 132; hind foot, 26; ear (from crown), 23. Skull—Total length, 28.7; basilar length, 21; nasals, 10.4; zygomatic expansion, 15; interorbital constriction, 4.3; length of mandible, 14.8; width of mandible, 7.5.

During a recent cursory examination of a series of thirty or more White-footed Mice from the West Cascade region of California south of San Francisco Bay, which had long laid in my collection as undoubted specimens of the "Parasitic Mouse" of Cooper, described in 1848, by Gambel, from a Monterey specimen under the name *Mus californicus*, I was surprised to find those from San Diego County uniformly of a grayer (less brown) color above and lacking the brown vent and fulvous suffusion of throat and breast characteristic of more northern specimens. A comparison of the skulls of these soon showed constant and specific peculiarities, the most striking being the posterior rounding of the frontal bones of San Diego County specimens contrasted with the peculiar right-angled aspect of the fronto-parietal sutures in typical *Peromyscus californicus.*

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[1] Bull. Amer. Mus. Nat. Hist., 1894, 343.

The ears of the southern species are much larger even than those of *californicus* and the size of the animal in length measurements considerably exceeds its rival.

The two have been confounded in previous descriptions and the southern form is probably responsible for the apparently exaggerated statements of the dimensions of typical *californicus.*

I am at a loss to account for the conditions described by Dr. J. A. Allen[3] regarding certain specimens of *Peromyscus* of the *californicus* type from Santa Ysabel and Dulzura being darker and smaller than those from Santa Clara County, my own series showing exactly reversed characters.

I may also state in this connection that none of my specimens from either locality have white-tipped tails.

3. **Thomomys altivallis** sp. nov. Type, ad. ♀, No. 1,927, Col. of S. N. Rhoads, San Bernardino Mts., California (alt. 5,000 ft.). Col. by R. B. Herron, Aug. 10, 1894.

Description.—Size medium, smaller than *T. toltecus* Allen, but larger than *T. monticolus* Allen. Above dull chestnut-brown, becoming darker dorsally and along upper sides of head, the middle crown and median line of back nearly black, the sides washed with the outer posterior corners, the latter coming far short of the nasal prolongations of the premaxillaries. Upper and lower incisors unusually wide and strong, the upper inner sulcus scarcely noticeable without a glass. Molar dentition likewise unusually massive. The coronoid process of mandible is more erect than usually seen in the genus and terminates in a sharp point.

Measurements (of type in millimeters).—Total length, 228; tail vertebræ, 74; hind foot, 29; arc of middle fore-claw, 11.5. Skull—Total length, 39.7; basilar length, 34; greatest zygomatic width, 23.2; interorbital constriction, 7; length of nasals, 13; terminal width of upper pair of incisors, 4.6.

Three specimens of this gopher, taken at varying elevations of from 5,000 to 7,000 feet in the San Bernardino Mountains by Mr. Herron, form the basis of the foregoing description.

Though somewhat affected by albinism, as stated in the description, I have chosen the type as being the most typical of the three specimens, the other two being less fully developed in cranial characters and are in more worn pelage. The type may be considered representative of the maximum development of the species, the others averaging considerably less in body and cranial measurements. This species may be compared to three described forms. From *T. toltecus* it differs in a smaller body, longer tail, and much smaller and more elongate skull, also in the darker upper and very much darker lower body colors; from *T. monticolus* the San Bernardino gopher differs radically in the small size and narrowness of the interparietal, in the marked prolongation and acuteness of the fronto-intermaxillary suture beyond the nasals, in its wide mastoid and zygomatic development, and in the diminution of the inner ridges of the faces of the upper incisors. In color, *altivallis* differs from *monticolus* in a less marked degree, but in the same respects as already described in its separation from *toltecus*. In some respects *altivallis* resembles *bottæ* from Nicasio, California. It may be distinguished therefrom by its more fulvous shade above, by the dark dorsal stripe, black nose, and sooty under parts, and by the greater size of manus and strength of fore claws. Cranially *bottæ* is more massive, with a slender rostrum and weaker dentition, narrower interparietal and wide zygomæ. In *altivallis* there are no parietal ridges which are so characteristic of *bottæ* of same age.

4. **Thomomys bottæ pallescens** subsp. nov. Type, ad. ♂, No. 1,932, Col. of S. N. Rhoads, Grapelands, San Bernardino Valley, California. Col. by R. B. Herron, March 22, 1894.

Description.—Size large, feet, relatively, of medium size, with short, thick claws. Color above, dull, tawny-brown, lightest on rump, browner on nape, with blackish shade on head. Ears, hind-ear patch and chops, sooty; feet and lower surfaces of limbs, ash; breast, belly, vent and lower margin of sides, tawny-ash. Skull massive, angular; dentition relatively weak; interparietal longer than wide.

Measurements.—Total length, 260 mm.; tail vertebræ, 89; hind foot, 33.5; middle claw of manus, 9.2. Skull—Total length, 39; greatest zygomatic breadth, 24.4; basilar length, 35.5; length of nasals, 11.9; interorbital constriction, 6.9; length of mandible, 25.

A series of nine specimens from two localities in the San Bernardino Valley and two from Banning, California, show constant and easily recognized color differences from typical specimens of *bottæ* from Nicasio. The tail of type specimen is much longer than the average, which is about the same as in *bottæ*. The heavily ossified, angular skull, in all its characters, is similar to that of *bottæ*. What *Pallescens* is to *bottæ*, both geographically and anatomically, *Neotoma fuscipes dispar* is to *Neotoma fuscipes*.

5. **Thomomys fulvus nigricans** subsp. nov. Type, ad. ♂, No. 2,007, Col. of S. N. Rhoads, Witch Creek, San Diego Co., California. Col. by F. Stephens, Dec. 22, 1893.

Description.—Size small; tail rather short and well haired; pelage full and long. Color above, uniform blackish-brown, becoming have been compared with a series of *fulvus* loaned by the American Museum of Natural History through the courtesy of Dr. J. A. Allen. Specimens of same age and season from southern Arizona show that the San Diego County animal is uniformly blacker and less fulvous, but the close resemblance in cranial characters of the two series will not justify their separation as full species. Two specimens from the San Jacinto and Cuyamaca Mountains, respectively, taken at altitudes of five to six thousand feet, are identical with those from Witch Creek.

NOTE ON THOMOMYS PERPALLIDUS.

A large series of beautifully prepared specimens of *T. perpallidus* have incidentally been examined in my studies of the southern California forms. The cranial characters of these specimens compared with those of *fulvus* of similar age and size, show considerable agreement. Of these may be specially noted the broad interparietal, wide, heavy incisors and molars, and the slenderness of the bones of the zygomatic arch. Correlated with their cranial likeness it may be noted that darker summer specimens of *perpallidus* form a close intergrade of color with lighter examples of *fulvus*, connecting, in an unexpected manner, the extreme light phase of the former with the darker phase of the latter species. Not having specimens from any locality between Agua Caliente, California, and the San Francisco Mts., Arizona, I am unable to do more than conjecture whether an uninterrupted series would not justify naming the Mojave Desert Gopher *Thomomys fulvus perpallidus.* So far as the evidence goes, however, the relationship of the two animals is quite close.

Through the kindness of Dr. J. A. Allen, I was able to secure a loan from the American Museum of Natural History of typical specimens of several species of *Thomomys* from upper and Lower California and Arizona, without which the conclusions arrived at in this paper would have been of little value.

FEBRUARY 5.

MR. CHARLES P. PEROT in the Chair.

Twenty-four persons present.

The death of George A. Rex, M.D., a member, on the 4th inst., was announced.

On a New Method of Studying Cell Motion.—**CHARLES LESTER LEONARD**, M.D. communicated notes of a lecture delivered January 15, 1895:—

Since the enunciation by Virchow, in 1858, of his theory of cellular pathology the attention of the scientific world has been centered about the study of this unit. Nearly all the unsolved problems of medical science involve, in one way or another, the consideration of some one of the functions of the cell.

It is my purpose in this paper to call attention to a new method of studying one of these functions. I have chosen as illustrations, some of the well-known facts of physiology already seen and described by competent observers, and have confined the greater part of my study to cell motion as exemplified in the movements of the red and white blood corpuscles.

The possibility of these studies was suggested by the successful result of an experiment in instantaneous photomicrography.

The method to be illustrated consists in the making of a consecutive series of instantaneous photomicrographs of the same microscopic specimens is illustrated by six photomicrographs of human blood in the different forms which it assumes upon the warm stages.

The method of study is illustrated by the following series:—

Series A.—The amœboid motion of the white blood corpuscle. The change of shape and motion with relation to the surrounding stationary and identical fields is well marked.

Series B.—This series shows the power of the white blood corpuscle in forcing its way through a mass of red crenated and adherent blood corpuscles.

Series C.—Is of marked interest; a white corpuscle has seized upon a red corpuscle and a series of photomicrographs shows that it has dragged it through a considerable distance in a field which is proved to be stationary and identical in all the photomicrographs.

Series D.—This series shows motion in a red blood corpuscle, situated in a field in which the series proves no other motion took place during one-half hour. This motion must, therefore, have been produced by some inherent power in the red blood corpuscle, and as the photomicrographs show that no twist has occurred, the motion cannot be due to a previous torsion, and may therefore be considered a truly amœboid motion of the red blood corpuscle.

Series E. and *F.*—Show the diapedesis of the red blood corpuscle from a capillary in which the blood is in motion and from one in which there is stasis of the blood. This phenomenon, therefore, occurs under two opposite or nearly opposite conditions as regards intra-vascular blood pressure, indicating, perhaps, that diapedesis is not a filtration due to pressure, but is due to the amœboid motion and power of the red blood corpuscles.

Series G.—This series shows an empty capillary. Along the inner surface of its wall may be seen white corpuscles, in which the series indicates movement. The diapedesis of two red blood corpuscles from this empty capillary tends to strengthen the belief in the amœboid motion of the red blood corpuscle.

Further photomicrographs illustrate the position of the corpuscles within the capillaries, and show the presence of nuclei in the red corpuscles of the frog while in the living tissues. Different forms of the malarial plasmodia, and the application of the method to pathological studies are illustrated by other photomicrographs.

The pictures are not shown as the perfect results of this method, or as the outcome of research by it. They are simply to illustrate the author's method of studying cell motion. Inferences based on the pictures are foreign to the purpose of the communication, which is intended merely to demonstrate a method of study worthy of scientific consideration. Its usefulness in producing accurate illustrations, both for publication and for lantern slides, cannot be overestimated, as it supplies pictures whose counterpart can be found under the microscope.

FEBRUARY 12.

The President, GENERAL ISAAC J.. WISTAR, in the Chair.

Thirty persons present.

The Biological and Microscopical Section presented the following minute:—

GEORGE A. REX, M. D.

The Biological and Microscopical Section of the Academy of Natural Sciences of Philadelphia, in view of the sudden death of Dr. George A. Rex on the 4th inst., deem it appropriate that a minute be made upon its records in appreciation of the loss it has sustained.

Dr. Rex became a member of the Academy in January, 1881, and in December, 1881, he was elected a member of the Section. He served as its Conservator from November 3, 1890, until his death.

Dr. Rex was the highest authority on the Myxomycetes in the United States. It was his enthusiastic study of this group that first brought him to the Section, and his communications on this subject formed an interesting part of nearly every meeting. He was the author of numerous species, which, owing to his extreme conservatism, will doubtless continue to bear his name. Many forms, new to him, remained in his collection unnamed for years, and were only published when he had thoroughly convinced himself that they were really new to science.

Although he was interested principally in the Myxomycetes, he

February 19.

The President, General Isaac J. Wistar, in the Chair.

Twenty-four persons present.

A paper entitled "New Subspecies of the Gray Fox and Say's Chipmunk," by Samuel N. Rhoads, was presented for publication.

February 26.

The President, General Isaac J. Wistar, in the Chair.

Twenty-eight persons present.

Papers under the following titles were presented for publication:—

"The Eocene Tertiary of Texas east of the Brazos River," by Wm. Kennedy.

"Description of New Species of Achatinella from the Hawaiian Islands," by D. D. Baldwin.

"Notes on the Dentition and Jaws of Achatinellidæ," by Henry Sutor and H. M. Gwatkin.

Mr. Silas L. Schumo was elected a member.

P. B. Sarasin of Basel, Switzerland, was elected a correspondent.

The following were ordered to be printed:—

NEW SUBSPECIES OF THE GRAY FOX AND SAY'S CHIPMUNK.

BY SAMUEL N. RHOADS.

Urocyon cinereo-argenteus floridanus subsp. nov. Type, yg. ad. ♂. No. 1,837, Col. of S. N. Rhoads. Tarpon Springs, Florida. Col. by W. S. Dickinson, Dec. 1894.

Description.—Smaller than *cinereo-argenteus* of the Middle States, with relatively shorter hind foot, tail, and ears, and harsher pelage. Skull characters not appreciably different from the typical form. Crown from between eyes (including space between ears and eyes to black malar stripe), upper neck, back, rump, sides, upper surfaces of legs and feet mixed silver-gray, much as in the northern animal. Chin, margin of lips, whisker patch, upper line and tip of tail and an indistinct double stripe reaching from the nose through and under eyes and joining on cheeks, black. Hind ears, sides of neck to fore-legs, broad band across throat and under surface of foreleg rusty brown. Throat and cheek-stripe, from anterior canthus of eye, white. Anterior upper lip adjoining muzzle, brownish-white. Breast, belly, vent, inner surfaces of hams and inner base of fore-legs pale rusty fulvous, a few grayish-white hairs near vent. Soles of feet cinnamon, with dusky borders.

Measurements (of type, taken from dry skin).—Total length, 900 mm.; hind foot, 125; tail vertebræ, 260; ear, from crown, 60: (Of old, adult topotype; length, 910; foot, 125; tail, 310; ear, 63). Skull—

Jersey. It lacks entirely the white stripe on the inside of hind legs, and the rusty throat patch is much longer (3 or 4 inches) than in *cinereo-argenteus*, in which it often forms a narrow collar scarcely dividing the white of lower head and throat from that of breast.

As I have already pointed out,[1] priority in naming the Gray Fox belongs to Müller, who described it in 1776. Probably in the same year a plate of this animal had been published by Schreber (Saugthiere, Tab. XCII), on which he used the name "*Canis cinereo-argenteus* Briss." The text belonging to the volume (Band III) in which this plate was bound bears the date 1778. In the text Schreber nowhere imposes the Latin name because of his expressed doubt whether "Der Grisfuchs" might not be the same as "Der Virginische Fuchs," which he named *Canis virginianus*. It is, therefore, apparent that *cinereo-argenteus* was not adopted by Schreber but was merely quoted on the plate to denote the animal which he considered the same as the *Canis cinereo-argenteus* of Brisson. Schreber's plate of Der Virginische Fuchs is copied from the preposterous one of Catesby, while that of Der Grisfuchs is not a bad representation of the Gray Fox, and his description of the animal (pp. 360, 361) is the first accurate one published, in fact it would be hard to find a more reliable diagnosis of the external characters of the northern form than this of Schreber's, taken from a furrier's pelt, sent from America to Germany.

Returning to Müller's description we find the additional statement that his *Canis cinereo-argenteus* is based on Brisson's animal as well as on Schreber's plate above mentioned, but he gives no habitat. Brisson (Règne Animal, 1756, p. 241) gives it: "Habitat in Carolina, & Virginia in cavis arboribus." The Gray Foxes which I have examined from North Carolina and Virginia are essentially like those of the Middle States, and it is therefore proper to apply Müller's name to the northern as contrasted with the extreme southern form. It is probable that there is little intergradation between the two, north of southern Georgia and that typical *floridanus* is confined to peninsular Florida, as is the case with other mammals in these regions having the same distribution.

Tamias lateralis saturatus subsp. nov. Type, ad. ♂, Col. of S. N. Rhoads, No. 1,365. Lake Kichelos, Kittitas Co., Washn. (elevation 8,000 ft.). Col. by Allan Rupert, Sep., 1893.

Description.—Size large, tail very long, foot and ear in the same proportion, colors darkest of the *T. lateralis* group. Top and sides of head and sides of neck to and including forelegs, chestnut, shaded with black; eyelids pale buff, in marked contrast to their surroundings; lips, throat, breast, sides of belly and hams, rusty; feet paler rusty; back, from occiput to and including root of tail and defined laterally by red of neck and black of inner body stripe and posteriorly by white of middle stripe, including flanks and upper hind legs, grizzled, rusty black. White body stripe longest, reaching from base of neck nearly to tail; inner black stripe shortest, about half the width and length of outer stripe, which latter is the same width as white stripe, and about two-thirds as long. Belly and chest uniform grizzled black, the bases of hairs sooty, their tips fulvous. Tail, above, like back on proximal third, becoming more distinctly margined with a subterminal black band which becomes broader and blacker at tip, the outer tips of hairs rusty; beneath, the tail is lighter, with a broad central area of reddish-yellow within the black border. Skull, not appreciably different from that of *lateralis*, except in its larger size.

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[1] Reprint of Ord's Zoology, 1894, Appx., p. 8.

Measurements (of type, in millimeters).—Total length, 317; tail vertebræ, 114; hind foot, 46: (Average of five adults, length, 305; tail, 112; foot, 46). Skull—Total length, 46; basilar length, 38; zygomatic expansion, 28.8; interorbital constriction, 12; length of nasals, 15.7; length of mandible, 28; width of mandible, 16.2.

Seventeen chipmunks, taken by Mr. Rupert in the months of July and September, in the vicinity of Snoqualmie Pass, Cascade Mts., [redacted]

NEW AND OTHERWISE INTERESTING TERTIARY MOLLUSCA FROM TEXAS.

BY GILBERT D. HARRIS.

While employed as Tertiary paleontologist to the Geological Survey of Texas during the years 1892 and 1893, the writer prepared a large monograph on the Tertiary mollusca of the State with the intention of publishing it in the 5th Annual Report of that Survey. For want of funds the printing of this report has been indefinitely postponed, and accordingly the following facts and descriptions of new species, taken from the monograph in question, have here found an appropriate place for publication.

The points in stratigraphy brought out by the study of the various Tertiary faunas of the State have been included with other matter in an article published by the State Geologist in the Journal of Geology, 1894, p. 549.

Suffice it to say here that the Midway stage, so well developed in Georgia and Alabama and known also in Mississippi and Arkansas, exists also in Texas, as is proved by the occurrence of such species as *Enclimatoceras ulrichi, Ostrea pulaskensis, Cucullæa macrodonta, Volutilithes limopsis* and others.

The Lignitic stage, so far as has been observed, is destitute of molluscan remains. The exposure on Brazos River, known as "Smiley's Bluff," two miles above the mouth of Pond Creek, is evidently about synchronous with the Matthews Landing beds of Alabama. These are now included in the Midway stage.

The Lower Claiborne beds are replete with fossils, many of which are common to this horizon in Louisiana, Mississippi, Alabama, and South Carolina. Besides these well-known forms there are many new ones, some of which are described below.

The true Claiborne, the Jackson, and the Vicksburg stages seem to have no representatives in Texas. This fact cannot be too strongly emphasized since most writers on Texas geology have referred certain fossil bearing outcrops to some of these upper Eocene stages.

PELECYPODA.

Genus MODIOLA.

Modiola houstonia sp. nov. Pl. 1, fig. 1.

Specific characterization.—General form of shell as figured; thin, showing concentric lines of growth on the area below the umbonal ridge; above the same, with broad concentric undulations, becoming more numerous towards the umbones; anterior, radially striate.

Localities.—Three miles northeast of Crockett, Houston Co., Tex.; also five miles northwest of Orangeburg, S. C.

Geological horizon.—Lower Claiborne Eocene.

Type.—In Texas State Museum.

Modiola texana Gabb. Pl. 1. fig. 2.
Perna texana Gabb, Proc. Ac. Nat. Sci. Phila., 1861, p. 371.

The collections of the Survey have yielded few and imperfect specimens of this species.

Localities.—Caddo Peak, Texas, Gabb. Two miles southwest of Campbellton, Atascosa Co.; two miles east of Arnold's ranch, Frio Co., Tex. Near Red Land, La.

Geological horizon.—Lower Claiborne Eocene.

Specimen figured: From near Red Land, La., property of U. S. Nat. Museum.

Type.—In the Academy of Natural Sciences of Philadelphia.

Genus LEDA.

Leda bastropensis nov. sp. Pl. 1, fig. 3.

Har. since it lacks the smooth Yoldia-like aspect about the umbones so characteristic of that species.

Localities.—Rio Grande at Starr-Zapata Co. line; Brazos River, one mile below Milam-Burleson Co. line, Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—In Texas State Museum.

Leda milamensis nov. sp. Pl. 1, fig. 4.

Specific characterization.—General form as figured; surface covered with fine concentric striæ except near the anterior margin where it is smooth and polished; diameter from beak to base great and the shell here much inflated; posterior remarkably narrow and flattened.

Locality.—Smiley's Bluff, Brazos River, two miles above the mouth of Pond Creek.

Geological horizon.—Midway Eocene.

Type specimen.—In Texas State Museum.

Leda houstonia nov. sp. Pl. 1, fig. 5.

Specific characterization.—General form as figured; concentric lines scarcely discernible except where they pass over the umbonal ridge; post-umbonal area traversed by one raised line extending from the umbo to near the extremity of the valve; sometimes as many as eight or ten raised radiating lines appear near the posterior submargin.

Localities.—Between Orrell's and Evergreen Crossing, Elm Cr., Lee Co.; Alabama Bluff, Trinity River, Houston Co.; along Elm Cr. from Orrell's to Price's Crossing, Texas.

Specimens of this species occur in the collection of the Academy of Natural Sciences of Phila., labelled "*Leda* (*Nuculana*) *subtrigona* Con.?, S. Carolina."

Geological horizon.—Lower Claiborne Eocene.

Type.—In Texas State Museum.

Subgenus ADRANA.

Adrana aldrichiana nov. sp. Pl. 1, fig. 6.

Specific characterization.—Size and general form as indicated by the figure; exterior smooth and polished; within smooth; sinus small; posterior row of teeth much the longer.

The type specimen is compressed vertically, the umbo should be somewhat more elevated than is represented by the figure. The type and all the specimens seen by the writer were in the collection of T. H. Aldrich, temporarily loaned to the survey.

Geological horizon.—Lower Claiborne Eocene.

Locality.—Brazos River, Tex., one and one-half miles below Mosley's Ferry.

Genus VENERICARDIA.

Venericardia trapaquara nov. sp. Pl. 1, fig. 7.

Specific characterization.—General form as figured; ribs about twenty-four, compound, *i. e.*, broad at base, surmounted by a medial dentate carina; umbonal ridge prominent.

This species is remarkable for its quadrangular form and the prominence of its umbonal ridge. It belongs to the *alticostata* stock and is most nearly allied to *Cardita subquadrata* Con. (Jr. Ac. Nat. Sci. Phila., 2d Ser., 1848, p. 128, pl. 14, fig. 10), but from Conrad's description and figure it is evident that his species is much more compressed, the umbonal ridge less prominent, and the beaks more nearly central.

Locality.—Cedar Creek, southeast corner of Wheelock League, 200 yds. north of Brazos Co. line, Robertson Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus ASTARTE.

Astarte smithvillensis nov. sp. Pl. 1, figs. 8, a; 9, a, b, c.

A. conradi Buckley, 1st Ann. Rep. Geol. Agr. Surv. Tex., 1874, p. 63.
Crassatella alta (young) Heilp., Cont. to Geol., 1884, p. 38.
Astarte tellinoides Heilp., Proc. Ac. Nat. Sci. Phila., 1890, p. 402.

Specific characterization.—Size and general form as indicated by the figures; surface in typical specimens marked by strong concen-

Genus CRASSATELLA.

Crassatella texalta nov. sp. Pl. 2, fig. 2.

Specific characterization.—General form as figured; exterior smooth about the umbones, but marked by lines of growth anteriorly and sub-basally; hinge and marginal crenulations as in *C. alta* Con.

This species is closely allied to *C. alta*, but is distinguished by its proportionally longer form and its smooth umbones, the latter feature being in marked contrast with the corrugations of *C. alta*. It evidently does not attain the large dimensions of Conrad's species.

Localities.—Alabama Bluff, Trinity River, Houston Co.; Hurricane Bayou, Houston Co., Tex.; 2½ miles east of Newton, and 4 miles west of Enterprise, Miss.

Geological horizon.—Lower Claiborne Eocene.

Type specimen.—Texas State Museum.

Crassatella trapaquara nov. sp. Pl. 2, fig. 3, a.

Specific characterization.—General form as figured; surface concentrically striate anteriorly, smooth posteriorly, except a few shallow concentric depressions marking periods of growth; hinge teeth not so strong as in *texalta;* lunular margin concave; basal margin of the valves but slightly convex, crenulated within anteriorly and basally but not posteriorly.

Localities.—Smithville, Bastrop Co.; 8 miles east of Alto, Cherokee Co.; Elm Creek, between Orrell's and Evergreen Crossing, Lee Co.; Murchison's Headright, northern boundary, Houston Co.; R. Williams' Headright, northeast of Weches, Houston Co., Tex. Also Moore's Iron Mine, La., and near Enterprise, Miss.

Geological horizon.—Lower Claiborne Eocene.

Type.—Harris' collection.

Crassatella antestriata Gabb. Pl. 1, fig. 10, a.

C. antestriata Gabb, Journ. Ac. Nat. Sci. Phila., vol. iv, 1860, p. 388, pl. 67, f. 53.

Gabb's figure and description were of a young specimen; the figure herewith given is of an adult. Compared with *trapaquara*, *antestriata* is much more oblique, or inequilateral, the posterior extremity is sub-biangular and crenate within, and the basal margin is more convex. Externally *antestriata* is more strongly marked.

Localities.—Lee Co.; Elm Creek, between Evergreen and Orrell's Crossing, Lee Co.; Alabama Bluff, Trinity River, Houston Co.;

5 miles west of Crockett, Houston Co.; Hurricane Bayou, Marster's and Hodge's Survey, Houston Co.; Baptizing Creek, Cherokee Co.

Geological horizon.—Lower Claiborne Eocene.

Type.—Singley's collection, from Lee Co.

Crassatella texana Heilp. Pl. 2, fig. 1.

C. texana Heilp., Proc. Ac. Nat. Sci. Phila.. 1890, p. 406, pl. xi, f. 6.

This is certainly very distinct from *antestriata.* Besides the points of difference mentioned by Heilprin the following may be noted: The umbonal ridge is much sharper in *texana*, and there is a trace of a sinus just below it; the posterior margin is not sub-biangular as in *antestriata*, and the valves are less oblique.

From *trapaquara* this species can be distinguished by its surface markings, lower form, and the depression just below its umbonal ridge.

Localities.—Near McBee's School-house, 2 miles east of Alto; Berryman's Land, Kimble Headright, Cherokee Co.; Murchison's Headright; Lively's Place, Wilson Headright, Houston Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Apparently lost.

Genus SPHÆRELLA.

Sphærella (?) anteproducta nov. sp. Pl. 2, fig. 4.

Specific characterization.—Size and general form as indicated by the figure; anterior somewhat produced, laterally compressed; posterior dorsal margin likewise somewhat compressed; ventricose.

This species is much more ventricose than *inflata* Lea, from more or less corrugated concentrically towards the base, especially posteriorly; lunule in the larger specimens, very indistinct in the smaller forms bordered by a well incised line.

The surface markings resemble somewhat those of *C. nuttalliopsis* Heilp., but the anterior and posterior are too pointed, the shell in general too inflated, and the umbonal angle too great for that species. The larger specimens resemble *M. californica* Con.

Localities.—Rio Grande at Webb-Zapata County line; Smithville, Bastrop Co., 2 miles east of Alto, Cherokee Co.; Mosley's Ferry, Brazos Co.; Cedar Creek, Robinson Co.; Alum Bluff, Trinity River; Hurricane Bayou, Houston Co.; Collier's Ferry, Brazos River, Burleson Co.; cutting on Houston East & West Texas R. R., 4 miles north of Corrigan, Polk Co., Texas. Also from the base of the bluff at Claiborne, Ala.

Geological horizon.—Lower Claiborne Eocene.

Types.—Texas State Museum.

Genus TELLINA.

Tellina tallicheti nov. sp. Pl. 3, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; not twisted posteriorly; thin; posterior sub-biangulate; anterior rounded; beak slightly behind the center; lateral teeth well developed; posterior cardinal bifid; pallial sinus and muscular scars of good dimensions though rather dimly marked; exterior smooth, except a few concentric striæ on the post-umbonal slope; umbonal ridge passes from the beak to the posterio-basal margin.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Harris' collection.

Genus SILIQUA.

Siliqua simondsi nov. sp. Pl. 3, fig. 2.

Specific characterization.—Size and general form as indicated by the figure; anterior acutely rounded sub-basally, posterior rounded; from the umbo radiate two depressions (in the cast), the anterior deep, the posterior more nearly vertical and faint; pallial line and sinus comparatively well marked.

Locality.—Dr. Williams' quarry, Stephenson's Headright, Brazos Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CERONIA.

Ceronia singleyi nov. sp. Pl. 3, fig. 3, a.

Specific characterization.—General form as figured; beaks prominent, turned anteriorly; anterior side often very elongate; posterior generally short, obtusely pointed, with an obtuse angle midway of the posterior dorsal margin; umbonal ridge rounded; post-umbonal slope of considerable width and nearly at right angles to the face of the valve; substance of the valve moderately thick.

The young of this species have a decidedly *Schizodesma* appearance. Older specimens assume the general form of *Hemimactra elongata* of the Indo-Pacific region.

This species is known only in the form of casts in a light gray sandstone. It is regarded as a Mactroid shell, and not a *Macoma*, because (a) the beaks point anteriorly; (b) there is no indication of a twisting posteriorly; (c) the hinge margin of this shell is thick and evidently bore well-developed lateral teeth; (d) the posterior is very obtuse.

Locality.—Sunnyside Church, Lee Co., Texas.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus PERIPLOMA.

Periploma collardi nov. sp. Pl. 3, fig. 4.

Specific characterization.—General form as figured; nearly equivalve; beaks turned slightly backward; posterior deflected to the right; substance of the shell thin and very nacreous; umbones fissured.

Localities.—Smithville, Bastrop Co.; Burleson Shell Bluff on Brazos River; 2 miles east of Alto, Cherokee Co.; Mosley's Ferry, Brazos River; Cedar Creek, Wheelock League, Robertson Co.; Elm Creek, Robertson Co.; Berryman's Land, Cherokee Co.; Alum Bluff, Trinity River, Houston Co.; 2 miles south of Mt. Selmon P. O., Cherokee Co.; 1 mile south from Nevilles, Gonzales Co.; 15 miles southeast of Nacogdoches, Nacogdoches Co., Tex. Also near Enterprise, Miss.

Geological horizon of the variety.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus MARTESIA.

Martesia texana nov. sp. Pl. 3, fig 6.

Specific characterization.—General form as figured; surface marked by concentric lines or corrugations crossed by a radiating fold; anterior to this the lines are strong, but behind it they are very faint.

This species differs from *M. elongata* Ald., by its much greater anterior development, and hence the much more central position of the radiating fold.

Locality.—Two miles east of Alto, Cherokee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type specimen.—Texas State Museum.

GASTROPODA.

Genus RINGICULA.

Ringicula trapaquara nov. sp. Pl. 3, fig. 7.

Specific characterization.—Whorls 5; whorls 1, 2, and 3 nearly or quite smooth; 4 with a well marked subsutural line and fainter ones over the whole surface; body whorl strongly striate spirally, labrum very much thickened and crenulate within, labial callosity very pronounced, the two labial plicæ strong and ascending rapidly upon the body whorl.

This species differs from *R. biplicata* Lea by its more numerous spiral striæ, its greater oral callosities, and the obliquity and strength of the columellar plicæ. *R. mississippiensis* Con. has plications somewhat similar to those of this species, but in other respects it is nearly like *R. biplicata.*

Localities.—San Antonio Ferry, Brazos River, Burleson Co.; between Orrell's and Evergreen Crossing, Elm Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus VOLVULA.

Volvula? smithvillensis nov. sp. Pl. 3, fig. 8.

Specific characterization.—Shell large anteriorly and centrally but attenuated posteriorly; thick; spirally striate near either terminus; columella with one strong fold.

This shell has somewhat the form of *Actæonella.* It differs from *V. minutissima* by its greater thickness, its greatest diameter being located more to the anterior, and by its thick, strong columellar fold.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CYLICHNELLA.

Cylichnella atysopsis nov. sp. Pl. 3, fig. 9, a.

"*Volvula minutissima*" Gabb, specimen in coll. Ac. Nat. Sci. Phila.

Specific characterization.—General form globose as figured; substance of the shell rather thick; spirally striate; columella with one fold; umbilicated.

Locality.—Little Brazos River, near iron bridge, on Mosley's Ferry road.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum. Fig. 9a is the so-labelled *V. minutissima* of the Academy collection.

Genus TEREBRA.

Terebra texagyra nov. sp. Pl. 3, fig. 10.

T. polygyra Heilp., Proc. Ac. Nat. Sci. Phila., 1890, p. 398.

Specific characterization.—General form and size as indicated by

Aldrich and Meyer as "*T. divisura* Con., var." They give as localities, Claiborne and Lisbon, Ala.; Wautubbee and Newton, Miss.; Wheelock, Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Terebra houstonia nov. sp. Pl. 3, fig. 11, and Pl. 4, fig. 1.

T. polygyra Heilp. (*non* Con.), Coll. U. S. Nat. Mus.
T. vetusta Heilp. (*non* Lea), Proc. Ac. Nat. Sci. Phila., 1890, p. 398.
? *T. vetusta* Gregorio, Mon. Faun. Eoc. de l'Ala., pl. 1, figs. 40, 41.

Specific characterization.—Size and general form as indicated in the figure; whorls 12 or 13, longitudinally ribbed, the ribbing being much coarser in the upper part of the shell than in the lower; suture margined below by an obscurely impressed revolving line; columella straight, smooth, tapering rapidly.

This species is characterized at once by the height of its whorls in comparison to their respective diameters, the bulging sides of the whorls, the irregularities of the ribbing, and the straight, smooth columella.

Localities.—Smithville, Bastrop Co.; near McBee's school-house, Cherokee Co.; Little Brazos River, near iron bridge, on Mosley's Ferry road; Cedar Creek, Wheelock League, Robertson Co.; Elm Creek, Lee Co.; near Crockett and 2 miles west of Crockett, Houston Co.; Collard's farm, Sparks' Headright, Brazos Co.; Arnold's Ranch, Frio Co.; southeast of Campbellton, just south of Lipan Creek, Atascosa Co. Also in Claiborne, Webb, and Bienville Parishes, La.; 2 miles east of Newton, Miss.; Claiborne, Ala.; 2 miles west of Orangeburg, S. C.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CONUS.

Conus smithvillensis nov. sp. Pl. 4, fig. 2.

Specific characterization.—General form as figured; whorls about 12; smaller spiral whorls costate or crenulate; penultimate whorl smooth; body whorl smooth, except about 12 revolving lines at base.

This species bears much resemblance to the figure given in Proc. Ac. Nat. Sci. Phila., 1879, pl. 13, fig. 8, of "*Conus*" *pulcherrimus* Heilp., but upon examining the type of this species now in the Amer. Mus. Nat. Hist., N. Y. City, it was found to be, as already stated by Meyer, a Pleurotomoid shell. *C. parvus* of H. C. Lea is evidently the young of *sauridens* Con.

Locality.—Smithville, Bastrop Co., Tex.

Type.—Texas State Museum.

Genus PLEUROTOMA.

Pleurotoma enstriorina nov. sp. Pl. 4, fig. 3.

Specific characterization.—General form and size as indicated by the figure; whorls 10; nuclear whorls 1, 2, 3, 4 smooth, 5 costate, whorls 6, 7, 8, 9 ornamented by (a) a crenulated narrow band below the suture, (b) a narrow concave space in which there are two or three fine but distinct spiral striæ, (c) a broad costate band, (d) a spiral line or two, body whorl marked below the costate band by coarse spiral lines and with more or less apparent lines of growth.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Figured Type.—Texas State Museum.

Pl. (Pleurotomella) anacona nov. sp. Pl. 4, fig. 4.

Specific characterization.—General form as figured; whorls 8; 1 nearly or quite smooth; 2, 3, 4, 5, 6 with (a) a broad slightly concave band showing very faint spiral striæ and a deep retral curve in the longitudinal striæ, (b) a slight basal carina with two or three strong spiral lines and rather faint, slightly oblique nodules; body whorl with more or less alternating coarse and fine spiral lines from the nodose carina to the end of the beak.

Localities.—Well at Elgin, northeast corner of Bastrop County;

Figured specimen.—Texas State Museum.

Type.—Probably the specimen in the Academy's collection.

Pl. (Surcula) moorei Gabb. Pl. 4, fig. 6, a, b.

Turris moorei Gabb, Jour. Ac. Nat. Sci. Phila., vol. 4, 1860, p. 378, pl. 67, fig. 11 (not fig. 9 as stated in Gabb's text).
Pleurotoma tuomeyi Aldrich, Bull. Geol. Surv. Ala., No. 1, 1886, p. 31, pl. 3, fig. 11.
Pleurotoma tuomeyi Heilprin, Proc. Ac. Nat. Sci. Phila., 1890, p. 394.
Surcula moorei Heilp., Proc. Ac. Nat. Sci. Phila., 1890, p. 394.

This species shows considerable variation in form as indicated by figs. 6, 6a, 6b. The specimen in the collection of the Academy is of about the form and size of that represented by fig. 6, though it shows more prominent denticulations on the spire, approaching fig. 6b in this respect. Specimens of this species in the U. S. Nat. Mus. collection from Wood's Bluff, Ala., are slightly stouter in form, *i.e.*, have a shorter spire. This, however, is not always the case, for Aldrich's type from this locality is of nearly the normal form. The Alabama specimens all show denticulations on the upper spiral striæ, a feature apparently overlooked by Aldrich when describing his *Tuomeyi.*

Localities.—Smithville, Bastrop Co.; Little Brazos River, Cedar Creek, Wheelock League, Robertson Co.; Mosley's Ferry, Burleson Co.; Elm Creek, Lee Co.; Alabama Bluff, Trinity River, Houston Co., Texas. Also from Wood's Bluff, Ala.

Type.—Probably lost.

Geological horizon.—Lignitic, and Lower Claiborne Eocene.

Pleurotoma beadata nov. sp. Pl. 4, fig. 7.

Specific characterization.—General form as shown in the figure; whorls 9; 1, 2, 3 smooth, 4, 5 transversely costate, 6, 7, 8 obliquely costate, the costæ most pronounced not far below the suture and dying out below, evenly and coarsely striate spirally; suture bordered below by a raised crenulated line; body whorl either costate on its humeral portion or plain; evenly striate spirally; retral sinus shallow, canal long, straight.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Pleurotoma vaughani nov. sp. Pl. 4, fig. 8.

Specific characterization.—Size and general form as indicated by the figure; whorls about 11; 1, 2, 3 smooth and very small, 4 nodular, 5 nodular and with a subsutural line or band; 6, 7, 8, as 5, but also striate spirally; 9, 10 nodular costate, costæ showing a slight tendency to become oblique, mainly confined to the lower moiety of the whorls, strongly striate below, and with two noticeably large striæ on the carina, faintly striate above; body whorl with rather coarse spiral lines alternating in size from the carinal region to the end of the beak, supercarinal region faintly striate, costæ obscure, labrum striate within.

Localities.—Smithville, Bastrop Co.; Hurricane Bayou, Marsters' Survey, Houston Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Pleurotoma huppertzi nov. sp. Pl. 4, fig. 9.

Specific characterization.—Size and general form as indicated in the figure; whorls 11; 1, 2 smooth, 3–10 somewhat inflated submedially, longitudinal costæ obtuse, most prominent submedially, almost vanishing on the subsutural portions of the whorls, becoming short and nodular on the upper whorls, prominently striate spirally, the striæ often irregular and waving on the medial portions of the whorls; body whorl costate and spirally striate, striæ becoming of alternating strength on the beak.

Localities.—Bombshell Bluff, Colorado River, about 1½ miles west-northwest of Devil's Eye; Smithville, Bastrop Co., Tex.

A very closely allied form occurs at Wood's Bluff, Ala. The main difference consists in the different location of the retral sinus.

the figure; whorls 9; apical 1½ smooth, rather large, remaining whorls carinated centrally, and with evenly arranged rather low but distinct costæ, more prominent below the carina than above it, twelve in number on the body whorl; surface microscopically striate spirally, and with very fine lines of growth; aperture a little over one-half the whole length of the shell; columella long and slightly twisted below.

Locality.—7 miles south of Jewett, Leon Co.

Geological horizon.—Lower Claiborne Eocene.

Type.—Collection of T. H. Aldrich, Birmingham, Ala.

Pl. (Drillia) dumblei nov. sp. Pl. 5, fig. 2.

Specific characterization.—Size and general form as indicated in the figure; whorls about 10, strongly carinated, concave above, convex below, spiral striæ much more noticeable below the carina than above it; beak short, twisted, umbilicated.

Locality.—? Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Pl. (Drillia) dipta nov. sp. Pl. 5, fig. 3.

Specific characterization.—Size and general form as shown in the figure; whorls 9; 1, 2 smooth, 3 longitudinally costate, 4–8 medially carinate, carina ornamented by oblique nodules, just below the suture there is a raised line or band; body whorl with less prominent carinal nodules, but with a few well-defined raised spiral lines; canal short, slightly curved.

Locality.—Baptizing Creek, Kimble Headright, Cherokee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Pl. (Drillia) nodocarinata Gabb. Pl. 5, fig. 4.

Turris nodocarinata Gabb, Jour. Ac. Nat. Sci. Phila., vol. 4, 1860, p. 379, pl. 67, fig. 13.

Gabb's figure of this species is exceedingly poor and his types at the Philadelphia Academy are in a state of confusion. In one lot labelled "*Turris nodocarinata* Gabb, Eocene, Tex.," in Gabb's handwriting may be seen *P. nodocarinata*, young of *P. moorei*, *childreni* var., and *terebriformis*. On the card bearing the name *Turris nodocarinata* may be seen: *Pl. nodocarinata*, *childreni* var., and *terebriformis.* All those labelled *Pl. nodocarinata* in Heilprin's Texan collection are *terebriformis.*

The specimen herewith figured is large and well developed, while Gabb's specimen was evidently small. The sutural crenulation disappears on the larger whorls. Fine revolving striæ are often seen on the zone between the suture and carina.

Localities.—Two miles above San José on the Rio Grande; Smithville, Bastrop Co.; Wheelock, Robertson Co.; Mosley's Ferry, Brazos River, Burleson Co.; Cedar Creek, southeast corner of Wheelock League, Robertson Co.; Elm Creek, Lee Co.; Alabama Bluff, Trinity River, Houston Co.; Hurricane Bayou, near Crockett, Houston Co.; 2 miles east of Alto, Cherokee Co.; 1 mile south of Nevilles, Gonzales Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Types.—? Academy of Natural Sciences of Philadelphia.

Pl. (Drillia) prosseri nov. sp. Pl. 5, fig. 5.

Specific characterization.—Size and general form as indicated by the figure; whorls about 8; 1, 2, and sometimes 3, smooth; 4, 5, 6, 7 polished, a slightly raised band just below the suture, costæ large, obtuse, and somewhat obliquely set; body whorl with subsutural band not well defined, humeral area slightly concave and gently waved by the upward extension of the ribs, which are very large below; beak slightly striate spirally.

Localities.—Near Smithville, Bastrop Co.; Little Brazos River, near iron bridge on Mosley's Ferry road; near Crockett, Houston is not quite so great in comparison with the whole length of the shell.

This species is characterized mainly by its slim spire, blunt apex, and raised line at the suture.

Localities.—Hurricane Bayou, Marsters' Surv., near Crockett, Houston Co., and, according to Gabb, "Wheelock, Tex."

Geological horizon.—Lower Claiborne Eocene.

Type.—Academy of Natural Sciences of Philadelphia.

Pl. (Drillia) texacona, *nom. mut.* Pl. 5, fig. 7.
Drillia texana Con. *non* Gabb, Amer. Jr. Conch., vol. 1, 1865, p. 143.

Localities.—Little Brazos River, near iron bridge on Mosley's Ferry road; Cedar Creek, Wheelock League, Robertson Co.; Jones' farm, Hurricane Bayou, Houston Co.; Elm Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Probably the specimens in the Academy of Natural Sciences of Philadelphia.

Pl. (Drillia) texanopsis nov. sp. Pl. 5, fig. 8.

Specific characterization.—Form in general as figured, though the specimen drawn was young; whorls about 12; 1–5 smooth, tapering to a sharp point; other spiral whorls scarcely distinguishable from those of *texacona*, body whorl with faint revolving striæ, becoming stronger below; beak long, straight.

On the last or body whorl the costæ often become obsolete and a more or less distinct carina is developed; above which, or between which and the suture, the shoulder is slightly concave.

Localities.—Smithville, Bastrop Co.; Bombshell Bluff, Colorado River, Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Pleurotoma insignifica Heilp. Pl. 5, fig. 9.
Fusus nanus Lea, Cont. to Geol., 1833, p. 150, pl. 5, fig. 155.
Pleurotoma insignifica Heilp., Proc. Ac. Nat. Sci. Phila., 1879, p. 213, pl. 13, fig. 9.
Pleurotoma nana Meyer, Bericht über die Senckenbergische Naturforschende Gesellschaft in Frankfurt, a. M. Sonder-Ausdruck, 1887, p. 18.
Fusus (*Lirofusus*) *nanus* De Greg., Mon. Faun. Eoc. Ala., p. 87.

This species shows considerable variation at Claiborne. As a rule the larger specimens are not so strongly carinated as the specimen herewith illustrated. The type specimen of *Fusus nanus* at the Philadelphia Academy has been compared with the Texan form and there seems to be no reason for doubting their identity. Meyer was right in referring this species to *Pleurotoma*, and *Pl. nana* would stand were it not for the fact that Deshayes in 1824 (Desc. Coq. Foss. des Env. de Paris, p. 482, vol. 2, pl. 68, figs. 19, 20, 21, 22) used the same name for a Paris Basin shell. Cossman has referred Deshayes' shell to the genus *Homotoma* (Bellardi, 1875) and has also referred other specimens to this genus which in general resemble Lea's and Heilprin's figures of *nana* Lea, and *insignifica* Heilp. At any rate the generic affinities of *nana* Lea, and *nana* Deshayes are too close to allow the retention of Lea's name; accordingly Heilprin's name, *insignifica*, must be adopted.

Lea's and Heilprin's characterization of this form being very imperfect, the following is offered:—

Size and general form as shown by the figure; whorls 8–10; 1, 2, 3 smooth, 4–8 with (a) a subsutural line, (b) a broad, faintly marked concave zone, (c) a strong carinal stria and just above it sometimes a faint line, (d) a strong subcarinal revolving line; body whorl with the subsutural line or band; the concave zone marked by curving longitudinal striæ and faint spirals; carinal angle 110°; subcarinal space with about twenty-five revolving lines somewhat alternating in size; labrum within sometimes with one or two blunt, tooth-like elevations located back some distance from the margin.

Localities.—Smithville, Bastrop Co.; Little Brazos River, near iron bridge, on Mosley's Ferry road. Also Claiborne, Ala.

Geological horizon.—Lower and Upper Claiborne Eocene.

from Calhoun Co., Fla. In Texas: Smithville, Bastrop Co.; College Sta., Brazos Co.; 2 miles west of Crockett, and on Jones' farm, Hurricane Bayou, Houston Co.; Collard's farm, Town Branch, Brazos Co.

Geological horizon.—Lower Claiborne Eocene, Vicksburg Eocene, Lower Miocene.

Type.—Aldrich's collection.

Pl. (Borsonia) plenta nov. sp. (by Ald. and Har.). Pl. 5, fig. 11, a.

Specific characterization.—General form as indicated by the figure; whorls 13 or 14; 1, 2, 3 smooth, globose; 4 slightly nodular or subcostate submedially and with an elevation just below the suture; 5, 6, 7 subcarinate with nodules on the carinæ; 8, 9, 10, 11 carinate submedially, carina bisected by a depressed spiral line; space between the carina and suture above concave, traversed by about six spiral striæ of equal size, with a slightly elevated band just below the suture; 12 and 13 obtusely carinate with about six fine lines above and four below; body whorl finely striated above the carina and for a short distance below, thence coarsely or alternately striate to the end of the canal; outer lip sharp, liræ within exclusively confined to the inflated portion of the shell and disappearing some distance before reaching the margin of the lip; inner lip very thin showing only on well-preserved specimens; columella with one strong plait located three-fourths of the way from the base to the upper terminus of the aperture.

In a few specimens there are traces of a second plait on the columella a short distance below the one referred to above.

Localities.—Smithville, Bastrop Co. (rare); Wheelock, Robertson Co.; Mosley's Ferry, Brazos River, Burleson Co.; Cedar Creek, Wheelock League, Robertson Co.; College Sta., Brazos Co.; Campbell Creek, Robertson Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Pl. (Eucheilodon) reticulatoides nov. sp. Pl. 5, fig. 12.

Specific characterization.—Size and general form as indicated by the figure; whorls about 10; 1, 2, 3 smooth, tapering rapidly to a point; 4 more or less costate; remaining whorls ornamented as follows: just below the suture, a raised line or band, below which a sunken zone is marked in the larger whorls by from one to three spiral incised lines crossed obliquely by lines of growth giving this portion of the whorl a cancellated appearance; on the body whorl, below the three or four cancellated strong medial spiral lines, there are from 15 to 18 more or less crenulated spiral lines, tending in some instances to alternate in size; labrum within with strong lirations; columella rather long, straight, and with one strong plait located above the middle, below which there are generally several minor folds, decreasing in size downward.

In many of its features this species is intermediate between the young of *Borsonia plenta* as here figured and *Eucheilodon reticulata.*

Locality.—Mosley's Ferry, Brazos River, Tex.

Type.—Texas State Museum.

Pl. (Taranis) finexa nov. sp. Pl. 5, fig. 13.

Specific characterization.—Size and general form as indicated by the figure; whorls 6; 2 nuclear, smooth; remaining whorls with (a) a subsutural raised ridge, (b) a strong medial carina, (c) a prominent raised line between the carina and the suture below, (d) fine costæ passing perpendicularly on the lower half of the whorl and obliquely to the left from the carina to the suture above; body whorl bicarinate, between the two carinæ, a strong raised line, below the carina about six raised spiral lines; columella slightly concave; labrum within showing channels and ridges corresponding to the exterior marking.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

or two humeral lines, (c) one prominent line on the humeral angle, (d) many alternating lines below, (e) numerous costæ (15 on the body whorl), most prominent on the humeral angle.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CANCELLARIA.

Cancellaria panones nov. sp. Pl. 6, fig. 1.

Specific characterization.—Size and general form as shown in the figure; whorls 5; 1 and 2 smooth; 3 and 4 with sharp Scala-like costæ, shoulder narrow, slightly convex; body whorl shouldered as 3 and 4, with about fifteen smooth sharp costæ, spirally striate below; mouth ovate triangular, with about ten labrum crenulæ and three columellar folds; umbilicus not very large.

In this species the ribs are often somewhat irregular. On the spiral whorls two or three ribs are considerably larger than the others. The costæ just behind the aperture are generally of small size or evanescent.

Localities.—Smithville, Bastrop Co.; 2 miles east of Alto, Cherokee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

C. panones, var. smithvillensis nov. var. Pl. 6, fig. 2.

Differs from the typical form in having spiral striæ; about four on the lower spiral whorls and fourteen on the body whorl. The mouth is slightly larger in proportion to the length of the shell.

Localities.—Smithville, Bastrop Co.; Little Brazos River, near iron bridge on Mosley's Ferry road; Orrell's crossing, Elm Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

C. panones, var. junipera nov. var. Pl. 6, fig. 3.

In this variety the spiral striæ are quite numerous, the mouth is small in comparison with the length of the shell, and there are but two prominent columellar folds.

Localities.—Smithville, Bastrop Co.; Bluff on Colorado River, just below the mouth of Alum Creek, not far above Smithville;

Cedar Creek, southeast corner of Wheelock League, Robertson Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Cancellaria penrosei nov. sp. Pl. 6, fig. 4.

Specific characterization.—Size and general form as indicated by the figure; whorls 5; 1, 2, 2½ smooth; 3, 4 cancellated by about 18 sharp ribs over which pass 5 spiral lines, the uppermost on the humeral angle and some little distance above the others; body whorl with about eighteen costæ and twelve revolving lines, the uppermost of which, on the humeral angle is separated from the next below by a double space; aperture with two columellar folds and about six labral crenulæ; umbilicus moderate. Surface not polished as in the two above-described species.

Localities.—Smithville, Bastrop Co.; Dr. Williams' quarry, R. Stephenson's Headright, Brazos Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Cancellaria bastropensis nov. sp. Pl. 6, fig. 5.

Specific characterization.—Size and general form as shown in the figure; whorls 7; nuclear whorls 2½, of which two are smooth, and the last half finely cancellated; 4, 5, 6 somewhat irregularly costate, about ten costæ on the penultimate whorl; spiral striæ few and strong on the sides of the whorls, but becoming more closely set and finer on the subsutural region; body whorl with irregular, obtuse two prominent folds on its central portion and a third, rudimentary one below; umbilicus small.

Locality.—Elm Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Cancellaria ellapsa Con., Amer. Jour. Conch., vol. 1, 1865, p. 212, pl. 21 (not 20), fig. 8.

This Conrad describes as an Eocene species from Texas, but it proves upon examination to be nothing but "*Trichotropis cancellaria* Con.," a species described by Conrad from the Ripley Cretaceous beds of Mississippi. The Texas specimen was probably derived from the upper Cretaceous not far below Austin.

Genus VOLVARIA.

Volvaria gabbiana nov. sp. Pl. 6, fig. 7.

Marginella (*Volvaria*) *gabbiana* Ald., MS., pl. 2, fig. 13.

Specific characterization.—Size and general form as shown by the figure; whorls 3; 1, smooth; 2, spirally striate; body whorl long cylindrical, spirally striate with faint punctations in the striæ; labrum sharp-edged; labium with four basal folds varying in size as follows: at base a moderate sized fold, above, a stronger one, still above, a moderate sized one, and above all, a very faint one.

Localities.—Devil's Eye, Colorado River, Bastrop Co.; bluff just below the mouth of Alum Creek, Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus VOLUTILITHES.

Volutilithes dalli nov. sp. Pl. 6, fig. 8, a.

Caricella reticulata Heilp., *non* Ald., Proc. Ac. Nat. Sci. Phila., 1890, p. 396.

Specific characterization.—Size and general form as indicated by the figures; whorls about 7; spiral whorls and shoulder of the body whorl generally coarsely cancellated with revolving lines and transverse costæ; humeral angle of the body whorl often spinose; medial portion of the body whorl with finer but very distinct revolving striæ and fine lines of growth; base of body whorl as in other members of this genus; labrum strongly lirate within; columella with two well-defined oblique plaits and sometimes one or more rudimentary ones.

The amount of reticulation or ornamentation possessed by different individuals of this species varies greatly. Some specimens are quite smooth on the medial portion of the body whorl, and show but slight irregularities on the shoulder. A form of this character is shown in fig. 8a. Such specimens have usually two well-marked folds on the columella and no trace of additional ones.

This species is evidently related to *V. haleanus* Whitfd., but is less strongly sculptured, and wants the peculiar concave humeral zone of that species. Moreover, *haleanus* has three distinct and well-defined columellar plaits.

This species is named in honor of W. H. Dall, the well-known authority on *Volutidæ*.

Localities.—Smithville; Cedar Creek, Robertson Co., Tex.

Horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CARICELLA.

Caricella demissa Con., var. **texana** Gabb. Pl. 6, fig. 9.

Cimbiola texana Gabb, Jour. Ac. Nat. Sci. Phila., vol. 4, p. 382, pl. 67, fig. 33.
Caricella demissa Harris, Exp. Sta. Rept., pt. 1, Geol. and Agr., 1892. A Preliminary Report upon the Hills of La., by Otto Lerch, p. 29.

Gabb cites his *C. texana* from "Wheelock, Tex." His specimen was evidently small and badly preserved. Normally there are six whorls. The columella is considerably recurved, but this is a feature that could not be determined from a specimen lacking its anterior canal as did Gabb's type. The ornamentation of the spiral whorls consists of revolving lines, more distinct above, and more or less regular and apparent longitudinal plaits. Below the suture there is

Localities.—Mosley's Ferry, Brazos River, Burleson Co.; two miles west of Crockett, Houston Co.; Collier's Ferry, Burleson Co.; two miles east of Alto, Cherokee Co.; Collard's farm, Sparks' Headright, Brazos Co., Texas.

Geological horizon of the variety.—Lower Claiborne Eocene.

Type of the variety.—Texas State Museum.

Genus TURRICULA.

Turricula (Conomitra) texana nov. sp. Pl. 6, fig. 11.

Specific characterization.—Size and form as indicated in the figure; whorls 5; nuclear whorl obtuse, smooth; other spiral whorls ornamented by longitudinal costæ, and a slight, subsutural depression; body whorl with much more numerous costæ, a slight subsutural depression, surface without a trace of spiral lines and polished; columella 4-plaited, the penultimate the largest; labrum crenulate within.

Localities.—Well at College Sta., Brazos Co.; Alabama Bluff, Trinity River, Houston Co.; Hurricane Bayou, near Crockett, Houston Co.; Collard's farm, Town Branch, Brazos Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus LEVIFUSUS.

Levifusus trabeatoides nov. sp. Pl. 6, fig. 12, a.

Fusus trabeatus Heilp. (not Con.), Proc. Ac. Nat. Sci. Phila., 1890, p. 395.

Specific characterization.—General form as figured; whorls 8 or 9; 1, 2, 3 smooth and polished, 4 sub-biangulate, 5, 6 with one spiral line just below the suture and two or three more near the base of each whorl where they are crossed by sharp, fine, costæ, 7 evenly striate spirally showing more or less distinct costæ and curving lines of growth; body whorl evenly striate, bicarinate, with faint indications of tubercles on each carina, lines of growth with a retral curve above the upper carina resembling those of *Surcula;* labrum strongly striate within.

Below the two prominent carinæ there is a third faint one. Large old specimens sometimes show on the body whorl one very strong carina above, while the two lower are rudimentary. Fragments have been obtained which would indicate a total length of an entire specimen of at least three inches.

The generic name *Levifusus*, as far as the writer is aware, has never been characterized; yet since Conrad has referred to it the species formerly described as *Fusus trabeatus* and *Busycon? blakei*, its characters must be fairly familiar to every worker in Tertiary paleontology. They may be summed up as follows:—

Shell of Fulgurate aspect and affinities (not Fusoid as the name unfortunately indicates); with three carinæ on the body whorl, the uppermost strongest and generally spinose, the second less distinct and less frequently spinose, the third or lowest generally faint and obtuse and with no signs of tubercles or spines.

Besides the two species referred to this genus by Conrad, the writer has added two more, viz., *Levifusus branneri*, originally described from the White Bluff horizon of Arkansas, and *L. trabeatoides*.

At Wood's Bluff, Ala., there is a form of *Levifusus* with characters intermediate between *L. trabeatus* and *L. trabeatoides* and it is doubtless the ancestral type of both. This prototype may then be regarded as having produced the true *L. trabeatus* in Alabama, while in Texas the *L. trabeatoides* was developed. *L. blakei* is somewhat more tuberculate on its uppermost carina than *L. trabeatus* or *L. trabeatoides* but is not so strongly marked as *L. branneri;* the last-mentioned species the writer has recently found in typical Jackson Eocene deposits at Moody's Branch, Jackson, Miss.

Localities.—Rio Grande, 2 miles above San José, Tex.; Mosley's Ferry, Brazos River; Colorado River, bluff just below the mouth of Alum Creek; Rio Grande, 15 miles below Carrizo; Little Brazos River, near iron bridge on Mosley's Ferry road; Brazos River, 500

Genus LATIRUS.

Latirus singleyi nov. sp. Pl. 6, fig. 13.

Specific characterization.—Size and general form as shown by the figure; whorls 9?; 4, 5, 6, 7, 8 marked by obtuse rounded ribs, which extend from suture to suture, by five strong, waving spiral lines on each whorl, and by fine, sharp, and even lines of growth most plainly visible between the costæ; body whorl with six obtuse costæ and about 24 raised spiral lines which, in the humeral region, consists of one strong series between which finer lines alternate, but below all become equal; lines of growth sharp and distinct, but fine; columella with two strong, oblique folds and a rudimentary one below; labium extending in a thin polished plate over the columella; umbilicus rudimentary.

Locality.—Elm Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Latirus singleyi var. Pl. 6, fig. 13a.

This is smaller than the typical form and more slender with less distinct lines of growth.

Locality.—Hurricane Bayou, near Crockett, Houston Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus STREPSIDURA.

Strepsidura ficus Gabb. Pl. 7, fig. 1.

Whitneya ficus Gabb, Geol. Surv. Cala., Paleont., vol. 1, 1864, p. 104, pl. 28, fig. 216.

? *Bulbifusus inauratus* Heilp., Proc. Ac. Nat. Sci. Phila., 1890, p. 396.

The specimen figured is about one-half the size of the California types and is eroded at the summit. Other specimens, though upon the whole less perfect, show the surface markings much better than the figured specimen does.

Localities.—"Ft. Téjon, Cal.," Gabb; Alum Creek Bluff, Colorado River, not far above Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus FUSUS.

Fusus bastropensis nov. sp. Pl. 7, fig. 2.

Specific characterization.—Size and general form as indicated in the figure; whorls 13 or 14; 1 and 2 very minute, smooth, 3 and 4 transversely costate, 5–12 with nodose obtuse ribs, distinct in 5, 6, etc., but less marked in 11 and 12, crossed by six or seven spiral raised lines, coarse or strong near the base of each whorl; one spiral line, generally the second from the base forms a slight carination on the whorls; body whorl with broad nodulations, about seven in number, and with strong spiral raised lines, the two on the largest part of the whorls being largest, above which there are two or three well-marked lines and below which to the end of the canal the lines gradually decrease in size and are more or less alternating; labrum, as far as observed, non-striate within; columella long, smooth, and straight.

This resembles somewhat *F. meyeri* Ald.

Localities.—Smithville, Bastrop Co., Tex. Also in Claiborne and Bienville Parishes, La.

Geological horizon.—Lower Claiborne Eocene.

Type.—Coll. of G. D. Harris.

Fusus ostrarupis nov. sp. Pl. 7, fig. 3.

Specific characterization.—General form as figured; whorls 8; 1 and 2 smooth and polished, 3 sometimes polished, with long, undulating costæ, 4, 5, 6, 7 evenly striate spirally, and with seven or eight longitudinal costæ; costæ decreasing in size about or just below the suture where a slightly depressed zone occurs; body whorl with eight or ten costæ somewhat variable in size, subsutural zone much compressed, spiral striæ moderately even but slightly strongest on the largest part of the whorl; labrum strongly striate within; columella recurving; umbilicus rudimentary.

Genus CLAVILITHES.

Clavilithes regexus nov. sp. Pl. 7, fig. 6.

This species is too poorly represented in the collection of the Survey to admit of complete characterization specifically. It is comparable in size with *C. penrosei* Heilp., and resembles the latter in the lower part of the whorls and in the long, smooth columella. Above, however, it shows no traces of a shoulder, the whorls are slightly flattened laterally, and are smooth and polished.

Localities.—Near McBee School-house, Cherokee Co.; between Orrell's and Evergreen Crossing, Elm Creek, Lee Co.; 2 miles west of Crockett, Houston Co.; Berryman Place, Kimble Headright, Cherokee Co.; 3 miles north of Crockett, Houston Co.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Collection.

Clavilithes humerosus Conrad, var. **texanus** nov. var. Pl. 7, fig. 7.

Differs from typical *humerosus* in having the sides of the body whorl nearly rectilinear, in having a more prominent shoulder at the suture, and in being of a smaller size generally. Many specimens approach closely *Clavilithes longævus* of the middle Eocene of Europe.

Localities.—Near McBee school-house, Cherokee Co.; Alum Creek Bluff, Colorado River, Bastrop Co.; Wilson Reid Headright, Brazos Co.: Hurricane Bayou, Hodge's Headright, Houston Co.; northwest corner of Madison County; Collier's Ferry, Burleson Co.; Collard farm, Sparks' Headright, Brazos Co., Tex. Also in Claiborne and Bienville Parishes, La., and 2½ miles east of Newton, near Enterprise, Miss.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Clavilithes kennedyanus nov. sp. Pl. 7, fig. 8.

Specific characterization.—General form as figured; whorls 10 or 12; 1 and 2 probably smooth; 3–10 with nodular ribs most prominent on the lower portions of the whorls, crossed by raised spiral lines and by even lines of growth; body whorl in the type specimen very poorly preserved, but showing few signs of costæ; columella ponderous.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Clavilithes (Papillina) dumosus Con., var. **trapaquarus** nov. var. Pl. 8, fig. 1.
Fusus (*Papillina*) *dumosus* Harris, La. Exp. Sta., 1892. Rept. on the Hills of La., p. 29.

This is a heavier, more solid form than the typical *dumosus*; it has about two more spines on the body whorl and has a smaller apex.

Localities.—Brazos River, 1 mile below Milam-Burleson County line; near McBee School-house, Cherokee Co.; Alum Bluff, Trinity River, Houston Co.; 5 miles west of Crockett, Houston Co.; Hurricane Bayou, Marsters' Survey, near Crockett, Collier's Ferry, Brazos River, Burleson Co.; north of College, Crockett, Houston Co.; Dr. Collard's farm, Sparks Headright, Brazos Co. In Louisiana, near Mt. Lebanon, Bienville Parish.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CHRYSODOMUS.

Chrysodomus parbrazana nov. sp. Pl. 7, fig. 9.

Specific characterization.—General size and form as indicated by the figure; whorls 6; spiral whorls smooth, with a faint subsutural spiral line; body whorl ornamented with the subsutural line and about ten basal spiral lines; outer lip sharp edged, lirate within.

Locality.—Little Brazos River, near iron bridge, on Mosley's Ferry road.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus ASTYRIS.

Astyris bastropensis nov. sp. Pl. 8, fig. 2.

5, 6, 7 with about three coarse revolving raised lines, with obtuse regular longitudinal costæ; body whorl with regular strong raised lines on its larger portion and finer ones below, also with seven obtuse costæ over which the spiral lines pass; labrum with five or six crenulations within; a basal Nassa-like fold on the columella.

In a general way this species resembles *M. vanuxemi* Con., but the costæ are very different and show no signs of forming acute angles, folds or spines.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Subgenus ODONTOPOLYS.

M. (Odontopolys) compsorhytis Gabb. Pl. 8, fig. 6.

M. (*Odont.*) *compsorhytis* Gabb, Jour. Ac. Nat. Sci. Phila., vol. 4, 1860, p. 377, pl. 67, fig. 16.

Murex sp.? Harris, La. Exp. Sta., Rept. on Hills of La., pt. 1, 1892, p. 29.

According to Gabb the type of this species came from Wheelock, Tex., and was deposited in the collections of the Smithsonian Institution. Unfortunately it has been lost. The State Survey's collection has yielded no specimens of this species, but in the U. S. National Museum there is a specimen collected by T. Wayland Vaughan, from Hammett's branch, 2 miles east of Mt. Lebanon, Bienville Parish, La. This is herewith figured.

Gabb's figure of this species is very poor, while his description is good. His figure has been copied in Tryon's Structural and Systematic Conchology, vol. 2, 1883, pl. 43, fig. 4, and this in turn is copied in De Gregorio's Monograph Faun. Eoc. Ala., pl. 6, fig. 47.

Meyer's *Odontopolys triplicata*, Sonder-Abdruck aus "Bericht über die Senkenbergische Gesellschaft in Frankfurt a. M.," 1887, p. 7, pl. 1, fig. 6, is a Volute, perhaps the young of *V. petrosus*.

Genus PSEUDOLIVA.

Pseudoliva ostrarupis nov. sp. Pl. 8, fig. 3, a.

Specific characterization.—Size and general form as figured; volutions 6, spiral whorls shouldered and somewhat costate; suture obscured by foliæ developed by the intermittent mode of growth of the sutural callosity; body whorl below scarcely distinguishable from the non-umbilicate varieties of *Ps. vetusta*, while above, the shoulder and the sutural foliæ at once definitely characterize the species.

Locality.—Smiley's Bluff, Brazos River, 2 miles above the mouth of Pond Creek, Milam Co., Tex.

Geological horizon.—Midway Eocene.

Type.—Texas State Museum.

Pseudoliva ostrarupis, var. **pauper** nov. var. Pl. 8, fig. 4.

Genus TENUISCALA.

Tenuiscala trapaquara nov. sp. Pl. 8, fig. 7.

Specific characterization.—Size and general form as shown by the figure; whorls 12 or more; nuclear 4 smooth and polished; 5–11 traversed by fine sharp longitudinal costæ and numerous spiral lines, the latter consisting of five coarse lines occupying the medial and basal portions of the whorl and as many microscopic lines on a subsutural zone; body whorl generally but imperfectly preserved, sculpturing as in the whorls immediately above, the base, however, being exposed, shows from 12 to 15 strong spiral lines.

Localities.—Mosley's Ferry, Brazos River, Burleson Co.; Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

T. trapaquara, var. **engona** nov. var.

Slightly shorter, more angulated, and with a broad subsutural band without strong revolving striæ.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Genus SYRNOLA.

Syrnola trapaquara nov. sp. Pl. 8, fig. 10.

Specific characterization.—Size and general form as indicated by the figure; whorls 7; 1 small, sinistral; 2–7 polished, slightly tumid, with a well-marked suture; aperture moderate, striate within; one strong plait on the columella.

Localities.—Smithville, Bastrop Co.; Jones' farm, Hurricane Bayou, Houston Co., and in Mr. Singley's collection from Mosley's Ferry.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus PYRULA.

P. (Fusoficula) texana nov. sp. Pl. 8, fig. 11.

Odontopolys texana Aldr. Labelled specimens from Aldrich, now in the U. S. Nat. Mus.
Volutilithes? recta Aldr., MS. plates, pl. 2, figs. 12, 12a.

Specific characterization.—General form as indicated by the figure; whorls (in a mature specimen) at least 6; apex obtuse; whorls 1, 2 smooth; 3 spirally striate in part, and in part striate and costate; 4 and 5 with spiral raised lines alternating in size, and with longitudinal folds or costæ, the latter occasionally becoming varicose; body whorl marked by four spiral lines on the humeral region, below by three series of spiral lines, and by about twenty rather irregular longitudinal costæ; outer margin of the labrum sharp, within thickened and with rather irregular crenules; columella generally smooth; but sometimes with two irregular swellings just below the point of greatest curvature.

This is a very strange form. The apex is very obtuse and the nuclear whorls as a whole are generally deflected somewhat from the axis of the adult shell. So far the species is a true *Pyrula*. Moreover the striation is that of *Pyrula*, but the costation is more irregular than in any of the known species of that genus; in fact it varies from moderately fine Pyrula-like lines to strong varices. The swellings on the columella, though in no wise true plaits, are worthy of note. They are evidently of the same origin and nature as those in *Mazzalina*.

Localities.—Mosley's Ferry, Brazos River, Burleson Co., Little Brazos River, near iron bridge; Cedar Creek, Lee Co.; Dunn's

Ranch, Robertson Co. This species is also found in various places in Bienville Parish, La., and in Mississippi 2½ miles east of Newton.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CYPRÆA.

Cypræa kennedyi nov. sp. Pl. 8, fig. 12, a.

Specific characterization.—General form and size as indicated by the figures; oral or front surface strongly ribbed transversely, ribs tending to divaricate; mouth moderately wide above, broad submedially and contracted below with one plait-like fold on either side; back smooth except near the margins where there are strong radiating lines.

Locality.—Dr. Collard's farm, Town Branch, Sparks Headright, Brazos Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus RIMELLA.

Rimella texana nov. sp. Pl. 9, fig. 1.

Specific characterization.—Size and general form as indicated by the figure; whorls 11; 1 exceedingly small, smooth; 2, 3, 4, 5 smooth and polished; 6, 7 faintly and finely cancellated; 8 with small longitudinal plicæ crossed by minute spiral striæ; 9, 10 more strongly plicate longitudinally, plicæ most strongly developed midway of the whorls; body whorl plicate superiorly though not immediately below the suture; spiral striæ very fine over the plicæ but coarse above the posterior canal extends nearly or quite to the apex of the spire, and recurving descends to near the body whorl. The only ornamentation is the spiral striation at the base of the body whorl, and sometimes faint costæ near the apex.

Localities.—Two miles east of Alto, Cherokee Co.; near McBee School-house, Cherokee Co.; Collier's Ferry, Brazos River; 2 miles west of Alto, Cherokee Co.; Sulphur Springs, Rusk Co.; Robbins' well, Houston Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus CERITHIUM.

Cerithium webbi nov. sp. Pl. 9, fig. 3.

Specific characterization.—General form of young specimens as shown in the figure; whorls about 9; spiral ones marked by two submedial approximate spiral rows of crenules or nodes above which, and just below the suture, is a third row with smaller crenulations; suture deep and broad; body whorl marked somewhat as those above though the lower submedial row of crenules is faint, and below it to the end of the beak occur spiral raised lines of varying strength; the entire surface is apparently covered with minute revolving lines; lines of growth on the body whorl start at right angles to the suture above, pass downward to the middle of the whorl, curve gradually forward and, after reaching the base of the whorl, slowly again curve backward and pass downward on the canal.

Locality.—Rio Grande, 13 miles by river below Laredo, or 9 by river above the Webb-Zapata County line, Texas side.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Cerithium penrosei nov. sp. Pl. 9, fig. 4.

Specific characterization.—Whorls at least 15, gradually tapering, ornamented as follows: by (1) about seven laterally compressed, oblique subcentral or basal nodes, or costæ on each whorl, those on the smaller whorls of the spire not so distinctly defined as represented by the figure; by (2) spiral lines or striæ, about five of which are strong and occupy the lower one-third of each whorl, three or four more are finer and occupy a narrow, irregular central zone, while four or five more occupy the upper or non-costate portion of the whorls.

The costæ on the several whorls are arranged in lines corresponding in direction to the obliquity of the costæ.

Unfortunately only fragments of this large *Cerithium* have been found; it doubtless measured eight or ten inches in length when entire.

Locality.—Smiley's Bluff, Brazos River, 2 miles above the mouth of Pond Creek, Milam Co., Tex.

Geological horizon.—Midway Eocene.

Type.—Texas State Museum.

Genus MESALIA.

Mesalia claibornensis Con. (MS). Pl. 9, fig. 5.

Specific characterizations.—Size and general form as indicated by the figure; whorls about 15; sides of the whorls nearly rectilinear; sides of the spire taken as a whole slightly concave; surface of each whorl ornamented by spiral lines of three sizes, of which there are from five to seven of the first and second, and double that number of the third magnitude, the latter are mere striæ; lines of growth faint or obscure; suture well defined but very narrow.

This species is similar in some respects to Conrad's *Mesalia vetusta*, but can at once be distinguished by the following differences: *claibornensis* has two or three more whorls; the sides of the spires are concave and not convex as in that of *vetusta;* the suture is less distinctly marked by a shoulder below it; there is a total lack of those strong lines or folds of growth so characteristic of *vetusta;* the lower angulation of the body whorl is more sharply defined.

Creek, Pleasanton, Atascosa Co., Tex. Also 5 miles southeast of Gibbsland, and 2 miles southeast of Mt. Lebanon, Bienville Parish, La.; 4 miles west of Enterprise, Miss.; base of bluff at Claiborne, Ala.

Specimens from the last-mentioned locality are somewhat less broad at base, more strongly striated spirally, and with slightly more rounded volutions than the typical Texan form. In the collection of the Academy of Natural Sciences of Philadelphia these Lower Claiborne forms are labelled by Conrad "*Mesalia claibornensis.*" I am not aware that the species has ever before been figured or described. It is one of the most abundant and characteristic of the Texan Eocene.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus TURRITELLA.

Turritella nasuta Gabb, var. **houstonia** nov. var. Pl. 9, fig. 6.

This variety differs from typical *nasuta* in being much broader at base, and having its whorls rounded or slightly carinated submedially. It is generally somewhat larger than the typical form, and is closely related to Conrad's *Mesalia lintea.*

Localities.—Rio Grande, at Webb-Zapata County line; Elm Creek, near Benchley; Alum Bluff Trinity River, Houston Co.; Dunn Ranch, Robertson Co. Also in South Carolina, near Orangeburg C. H.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Turritella dumblei nov. sp. Pl. 9, fig. 7.

Specific characterization.—Size and general form as shown by the figure; whorls about 15; the lower two to four show an obtuse basal carination while above, this feature is not so apparent; surface marked by raised spiral lines alternating in size, the carinal zones of the lower whorls are marked by two somewhat stronger lines; lines of growth plainly cutting the spiral lines and causing them to appear under a glass like diminutive strings of beads.

This species reminds one somewhat of *T. alabamiensis* Whitf., but is most probably nearest allied to *T. infragranulata* Gabb (Geol. Surv. Cal., Pal., vol. 1, 1864, p. 212, pl. 32, fig. 279), from near Martinez, Cal. Wherever the lines of growth are strong over the basal carina they tend to produce an "*infra-granulata*" appearance.

Localities.—Mosley's Ferry, Brazos River, Burleson Co.; Cedar Creek, Wheelock League; well at College Sta., Brazos Co.; Campbell Creek, Robertson Co.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Turritella dutexata nov. sp. Pl. 9, fig. 8.

Specific characterization.—Whorls (in a complete specimen) about 15; all marked by two subcentral carinal lines together with one small one just below and one just above the suture.

Besides the ornamentation shown on the specimen figured, there are usually about four spiral striæ on each whorl between the upper carinal and subsutural line; between the two strong carinal lines there is often a faint stria; likewise one often appears just below the lower carina. When fully striated this species bears a general resemblance to *T. arenicola* and *T. arenicola* var. *branneri*, but may be distinguished at once by the persistency of the bicarinate feature of the whorls to the very apex. The apical whorls of *T. arenicola* and variety are unicarinate somewhat as in *T. carinata* H. C. Lea (*T. apita* De Greg.). It will be observed that in Meyer's carefully drawn figure of *T. carinata* H. C. Lea, in the Proc. Ac. Nat. Sci. Phila., 1887, p. 54, pl. 3, fig. 1, 1a, two carinæ are represented on each whorl, but it is the upper one which predominates on the apical whorls; in *dutexata* it is the lower.

Localities.—Elm Creek, Lee Co.; Taylor's well, 5 miles southeast of Franklin, Robertson Co. (specimens in the U. S. Nat. Mus.);

(the only known specimen) as indicated by the figure; number of whorls unknown, ornamented by (1) fine even spiral striæ, (2) a subsutural row of pustules or crenules, and (3) a slightly raised or faint ridge at the base of each whorl becoming obsolete in the lower whorls, but increasing in strength above so as to nearly equal in size the subsutural line of crenules.

Locality.—Black Bluff, Brazos River, extreme northern limit of Milam Co., Milam Bluff of Penrose's Report.

Geological horizon.—Midway Eocene.

Type.—Texas State Museum.

Genus SOLARIUM.

Solarium huppertzi nov. sp. Pl. 9, fig. 10, a.

Specific characterization.—Size and general form of young specimens (no adults have thus far been found) as shown by the figure; whorls 3; mouth roughly hexagonal, bounded by the following lines: (1) the upper margin of the whorl, extending from a bicrenulate suture to a peripheral row of crenulations; (2) the exterior lateral margin of the whorl, extending from the row of crenulations just mentioned to a second or medial row; (3) the exterior sublateral margin of the whorl, extending from the medial row of crenulations to the basal row; (4) the basal margin of the whorl, extending from the basal row of crenulations to an interior sublateral row; (5) the umbilical margin; (6) the margin of contact with the penultimate whorl.

This shell is flat or discoid like the young of most members of this genus.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Solarium bastropensis nov. sp. Pl. 9, fig. 11, a.

Specific characterization.—Size and general form as indicated by the figure; whorls 4½; spire very low, marked only by the suture and a fine line just above it; body whorl depressed, somewhat carinate, marked on the periphery by three raised lines, and near the umbilicus by radiating lines of growth.

Locality.—Smithville, Bastrop Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Texas State Museum.

Genus AMAUROPSIS.

Amauropsis singleyi nov. sp. Pl. 9, fig. 12.

Specific characterization.—General form and size as indicated by the figure; spire pointed and high; whorls 7; body and penultimate whorls shouldered above as in *N. recurva*; umbilicus small, partially hidden by the labium; margin of the aperture sharp, reflected.

This species might be mistaken for the young of *recurva* were it not for the fact that the two have differently formed umbilici. In *recurva* there is a ridge formed by the continuation of the lower margin of the aperture that, after passing below and to the left of the umbilicus, winds up into the same as described by Aldrich. In *singleyi* the lower margin of the aperture stands out sharply. If traced upward and inward it will be found to follow the labium about one-third way across the umbilicus and then to wind up into the same.

Locality.—Cedar Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Collection of J. A. Singley.

Genus DILLWYNELLA.

Dillwynella? texana nov. sp. Pl. 9, fig. 13.

Specific characterization.—Size and general form as indicated by the figure; whorls 4; spiral, smooth, and shining; body whorl nearly smooth but showing a slight tendency to bear furrows or lines radiating from the suture; umbilicus small; mouth round.

somewhat of the upper surface of *Solarium bellastriatum;* body whorl rather large, rounded, slightly flattened above, with indistinct radial lines or lines of growth, flattened slightly below, rugose near the umbilicus; umbilicus small, Solarium-like, rendered somewhat hexagonal by the protruding peripheral dentes; mouth round; shell rather thick; general appearance like *Dillwynella naticoides.*

Locality.—Elm Creek, Lee Co., Tex.

Geological horizon.—Lower Claiborne Eocene.

Type.—Aldrich's collection.

EXPLANATION OF PLATES.

Plate 1.

Fig. 1. *Modiola houstonia* nov. sp.
Fig. 2. *Modiola texana* Gabb.
Fig. 3. *Leda bastropensis* nov. sp.
Fig. 4. *Leda milamensis* nov. sp.
Fig. 5. *Leda houstonia* nov. sp.
Fig. 6. *Adrana aldrichiana* nov. sp.
Fig. 7. *Venericardia trapaquara* nov. sp.
Fig. 8a *Astarte smithvillensis* nov. sp. (Typical).
Fig. 9a, b, c. The same, small variety.
Fig. 10. *Crassatella antestriata* Gabb.
Fig. 10a The same, viewed from within.

Plate 2.

Fig. 1. *Crassatella texana* Heilp.
Fig. 2. *Crassatella texalta* nov. sp.
Fig. 3. *Crassatella trapaquara* nov. sp.
Fig. 3a The same, viewed from within.
Fig. 4. *Sphærella anteproducta* nov. sp.
Fig. 5. *Meretrix texacola* nov. sp.
Fig. 5a The same, viewed anteriorly.
Fig. 5b Smaller variety of the same species.

Plate 3.

Fig. 1. *Tellina tallicheti* nov. sp.
Fig. 2. *Siliqua simondsi* nov. sp.
Fig. 3. *Ceronia singleyi* nov. sp.

Fig. 3a Smaller individual of the same species.
Fig. 4. *Periploma collardi* nov. sp.
Fig. 5. *Corbula aldrichi*, var. *smithvillensis* nov. var.
Fig. 5a The same, lesser value.
Fig. 6. *Martesia texana* nov. sp.
Fig. 7. *Ringicula trapaquara* nov. sp.
Fig. 8. *Volvula? smithvillensis* nov. sp.
Fig. 9. *Cylichnella atysopsis* nov. sp.
Fig. 9a The specimen labelled "*Volvula minutissima*" in th collection of the Academy.
Fig. 10. *Terebra texagyra* nov. sp.
Fig. 11. *Terebra houstonia* nov. sp.

PLATE 4.

Fig. 1. *Terebra houstonia* var.
Fig. 2. *Conus smithvillensis* nov. sp.
Fig. 3. *Pleurotoma enstricrina* nov. sp.
Fig. 4. *Pl.* (*Pleurotomella*) *anacona* nov. sp.
Fig. 5. *Pl.* (*Surcula*) *gabbi* Conrad.
Fig. 6. *Pl.* (*Surcula*) *moorei* Gabb.
Fig. 6a A somewhat larger, more carinated specimen.
Fig. 6b A strongly denticulate specimen.
Fig. 7. *Pleurotoma beadata* nov. sp.
Fig. 8. *Pleurotoma vaughani* nov. sp.
Fig. 9. *Pleurotoma huppertzi* nov. sp.

Fig. 11. *Pl.* (*Borsonia*) *plenta* nov. sp. by Ald. & Har.
Fig. 11a Apex of a very young and perfect specimen.
Fig. 12. *Pl.* (*Eucheilodon*) *reticulatoides* nov. sp.
Fig. 13. *Pl.* (*Taranis*) *finexa* nov. sp.
Fig. 14. *Pl.* (*Clathurella?*) *fannæ* nov. sp.
Fig. 15. *Pl.* (*Bela*) *rebeccæ* nov. sp.

PLATE 6.

Fig. 1. *Cancellaria panones* nov. sp.
Fig. 2. *Can. panones*, var. *smithvillensis* nov. var.
Fig. 3. *Can. panones*, var. *junipera* nov. var.
Fig. 4. *Cancellaria penrosei* nov. sp.
Fig. 5. *Cancellaria bastropensis* nov. sp.
Fig. 6. *Cancellaria ulmula* nov. sp.
Fig. 7. *Volvaria gabbiana* Ald. MS.
Fig. 8. *Volutilithes dalli* nov. sp.
Fig. 8a A smoother variety.
Fig. 9. *Caricella demissa*, var. *texana* Gabb.
Fig. 10. *Caricella subangulata*, var. *cherokeensis* nov. var.
Fig. 11. *Turricula texana* nov. sp.
Fig. 12. *Levifusus trabeatoides* nov. sp.
Fig. 12a Apex of the same magnified.
Fig. 13. *Latirus singleyi* nov. sp.
Fig. 13a Small variety of the same.

PLATE 7.

Fig. 1. *Strepsidura ficus* Gabb.
Fig. 2. *Fusus bastropensis* nov. sp.
Fig. 3. *Fusus ostrarupis* nov. sp.
Fig. 4. *Fusus mortoni*, var. *mortoniopsis* Gabb.
Fig. 5. *Fusus mortoni*, var. *carexus* nov. var.
Fig. 6. *Clavilithes regexus* nov. sp.
Fig. 7. *Clavilithes humerosus*, var. *texanus* nov. var.
Fig. 8. *Clavilithes kennedyanus* nov. sp.
Fig. 9. *Chrysodomus parbrazana* nov. sp.

Plate 8.

Fig. 1. *Clavilithes* (*Papillina*) *dumosus*, var. *trapaquarus* nov. va
Fig. 2. *Astyris bastropensis* nov. sp.
Fig. 3. *Pseudoliva ostrarupis* nov. sp.
Fig. 3a The same, front view.
Fig. 4. *Ps. ostrarupis*, var. *pauper* nov. var.
Fig. 5. *Murex fusates* nov. sp.
Fig. 6. *M.* (*Odontopolys*) *compsorhytis* Gabb.
Fig. 7. *Tenuiscala trapaquara* nov. sp.
Fig. 8. *T. trapaquara*, var. *engona* nov. var.
Fig. 9. *Pyramidella bastropensis* nov. sp.
Fig. 10. *Syrnola trapaquara* nov. sp.
Fig. 11. *Pyrula* (*Fusoficula*) *texana* nov. sp.
Fig. 12. *Cypræa kennedyi* nov. sp.

Plate 9.

Fig. 1. *Rimella texana* nov. sp.
Fig. 2. *R. texana*, var. *plana* nov. var.
Fig. 3. *Cerithium webbi* nov. sp.
Fig. 4. *Cerithium penrosei* nov. sp.
Fig. 5. *Mesalia claibornensis* Con.
Fig. 6. *Turritella nasuta*, var. *houstonia* nov. var.
Fig. 6a *T. nasuta*, typical.
Fig. 7. *Turritella dumblei* nov. sp.
Fig. 8. *Turritella dutexata* nov. sp.

THE EOCENE TERTIARY OF TEXAS EAST OF THE BRAZOS RIVER.

BY WILLIAM KENNEDY.

Since the publication of Dr. Hilgard's report on the Geology of Mississippi probably no other publication occupies so prominent a place among the geological literature of the tertiary deposits of the Gulf coastal slope as the "Tertiary and Cretaceous Strata of the Tuscaloosa, Tombigbee, and Alabama Rivers," by Smith and Johnson.[1] The Tertiary section there shown has been recognized not only as the section of the Alabama beds, but has also been considered as typical of the whole tertiary areas along the Gulf coast. Dall says that the Gulf section has been practically determined and its fauna largely recorded in this section, but he considers that important information and a rich fauna may be obtained from the Texas section,[2] and lately, Harris, in speaking of the same Bulletin, says: "It was not until 1886 that the typical section of American marine Eocene, namely, that of Alabama was published.[3]"

At that time (1888) very little was known regarding the Texas Tertiary. Desultory work, it is true, had been done by several observers, and some fossils figured and described by Gabb and others, but no continuous or connected work had been attempted, or, if so, the results were inaccessible and unknown. It was generally conceded, however, that it might be safely assumed from the geological conformation of the neighboring States that all or nearly all of the divisions ranging from the Eo-Lignitic to the Grand Gulf, inclusive, were represented, and that a considerable part belonged to the Lower Eocene as seen at Claiborne, Alabama, and in Clark County, west of Claiborne.[4]

In 1889 the first systematic work in those deposits was begun by Prof. R. A. F. Penrose, Jr. During that year he followed three of the great rivers: Brazos, Colorado, and Rio Grande, flowing across the Tertiary areas of the State, and the results of his examination have been published in the First Annual Report of the present Geological Survey.[5] Since that time the work of examining these beds has been carried on continuously throughout the eastern portion of the State almost altogether by myself, and the detailed results of these examinations, chiefly from a stratigraphic standpoint, have been published from time to time in the various Annual Reports of the Survey.[6]

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[1] Bulletin 43 U. S. G. S., by Dr. E. A. Smith and Lawrence C. Johnson.
[2] Tenth Annual Report U. S. G. S., 1888–89, p. 108.
[3] Am. Journ. of Sci., Vol. XLVII, April, 1894, p. 302.
[4] Heilprin, Cont. to Tert. Geol. of U. S., 1884, pp. 37, 38.

During the course of these examinations Prof. Penrose's river section along the Brazos was re-examined, the section seen along the Trinity River, and another extended section between the Trinity and Sabine made, and extensive areas throughout other portions of East Texas, were examined in detail.[7]

While a great portion of the stratigraphy had thus been worked out it has only been within the last year that any of the immense collections of fossils obtained during the course of the work have been critically examined and described.[8]

While the prediction of Dall as to the richness of the fauna of the Texas section has been fully verified, various other conditions have come to light which, while they largely verify the Alabama section, at the same time add strength to the all-important fact that the geological conformation of neighboring States cannot always be relied upon as a guide to the geology of any portion of the southern or Gulf Tertiary.

Alabama section:[9]—

				Feet.
Tertiary Eocene	Upper— White Limestone		Coral Limestone, Vicksburg ?	150
			Vicksburg (Orbitoidal)	140
			Jackson	60
	Middle	Claiborne		140–145
		Buhrstone		300
	Lower—Lignitic		Hatchetigbee	175
			Woods Bluff	80–85
			Bells Landing	140
			Nanafalia	200
			Mathews Landing, Naheola	130–150
			Black Bluff	100
			Midway	25

In the American Journal of Science Mr. Harris presents a general section of the Eocene series of the Southern States. This is based to a considerable extent on the Alabama section, but modified to include and harmonize with his own observations.[10] This section is:—

	Stages.	Sub-stages.	
Series Eocene	Vicksburg	Coral Limestone	
		Vicksburg Beds	
		Red Bluff Beds	
	Jackson	Moody's Branch Beds	
		Mark's Mills Red Beds	
	Claiborne	White Bluff Marls (Mk)	
		Claiborne sand	
	Lower Claiborne	Ostrea sellæformis Beds	
		Lisbon Beds	
		Buhrstone	
	Lignitic	Hatchetigbee Beds	
		Wood's Bluff Beds	
		Bell's Landing	Bell's Landing Beds
			Gregg's Landing Beds
			Nanafalia Beds
	Midway	Mathew's Landing Marl	
		Black Bluff Clays	
		Midway Clay and Limestone	

The work of the Texas survey shows the Eocene Tertiary of that portion of the State lying east of the Brazos River to have a section of:—

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[9] Bulletin 43, U. S. G. S., by E. A. Smith and L. C. Johnson, p. 18.

[10] Harris, Am. J. of Sc., Vol. XLVII, April, 1894, p. 304.

	Stages.	Sub-stages.	Thickness. Feet.
Series Eocene	Lower Claiborne	Frio Clays.	160
		Fayette Sands.	400
		Yegua Clays.	1,000
		Marine Beds.	650
	Lignitic	Queen City Beds	60–70
		Lignitic Beds.	1,000
	Midway	Basal or Wills Point Clays	260

The above section includes the whole of the Eocene deposits recognized in east Texas. As noted by Dr. Loughridge[11] the white limestones of the Claiborne are absent and neither the Vicksburg nor Jackson stages have been recognized, either paleontologically or stratigraphically, although both of these are reported as occurring a few miles to the eastward in Louisiana. The celebrated Claiborne sands are also absent.

No strata that might lithologically be referred to the *Ostrea sellæformis* beds have been recognized. *O. sellæformis* var. *divaricata* Lea, occurs in considerable numbers throughout the upper division of the Marine beds, and although increasing in number as this fossil ascends the scale, it can nowhere be said to be more characteristic of any of the beds than many of the other species found in association with it. This form of *Ostrea* has a vertical range of a little over two hundred feet.

It may also be said that no deposits corresponding to the Buhr-

Into the general section, however, three divisons of the Lisbon stage have to be introduced, all of which, so far as at present known, are peculiar to Texas. There are (a) Frio Clays, (b) Fayette Sands, and (c) Yegua Clays. These overlie the marine beds in the reverse of the order here given and together aggregate a thickness of nearly 1,500 feet in East Texas, while farther west this may be considerably exceeded.

FRIO CLAYS.

These clays form the uppermost division of the Eocene Tertiary as shown in the Texas section. They comprise a series of dark-blue, red, green, brown, and yellow clays when wet. They weather to pale blue, light red, watery green, gray, and pale yellow upon exposure and drying. In many places they carry numerous calcareous nodules, hard when freshly exposed, but in contact with the air they soon become soft and powdery, coating the exposures of the banks and outcrops with a fine, limy powder, and the clays themselves may be regarded as more or less gypseous throughout. In structure these deposits are sometimes laminated or partially stratified, but throughout their greater extent are massive and heavy bedded. The East Texas deposits appear to be unfossiliferous, but a considerable extinct fauna is reported from the beds lying in the central and western portions of the State.

Although reported as forming extensive deposits and covering a wide area throughout the region west of the Brazos[12] these clays thin out and are so covered by the overlapping Neocene deposits to the east of that river that their existence has only been noted at a few places. East of the Brazos these clays were first observed a short distance east of the town of Corrigan, in Polk County, where the section shows them to be dark-blue gypseous clays[13] and to lie between two beds of sandstone. Thirteen miles farther east, near Fleming,[14] an extensive outcrop of the same clays appears. Here, however, they present their calcareous features and appear to be devoid of selenite and are about 160 feet in thickness. Small outcrops appear at intervals along the Trinity and Sabine Railway and at Summit, in Tyler County, a section of a cutting on the Southern Pacific Railway shows the Frio clays to be about eighty feet in thickness and to be overlaid directly by the brown and gray sands of the latest Tertiary. The following section combined from two cuttings at Summit Station shows the relations of the Frio clays to the overlying and underlying deposits.[15]

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[12] Third Annual Report Geol. Survey of Texas, p. 116.

[13] Third Annual Report Geol. Survey of Texas, pp. 62-63, and 117-118.

[14] Dumble, Journal of Geology, Sept., 1894, p. 554.

Orange Sand or Lafayette.	1.	Gray sand with silicious pebbles	18 feet.
	2.	Conglomerate of silicious pebbles connected by a ferruginous matrix adhering to brown ferruginous sandstone, found in boulder form and in connection with an irregularly deposited stratum of ferruginous material changing gradually toward the north end of the cutting to a brown or pale red crossbedded sand interlaminated in places with lenticular shaped deposits of brownish-blue or pink clay	10 to 13 feet.
Frio Clays.	3.	Mottled-blue and brown sand clay	20 "
	4.	Pale watery-green sandy clay	20 "
	5.	Brown sandy clay	25 "
	6.	Pale blue sand and clay	15 "
	7.	Dark blue clay with limy concretions and gypsum crystals in places	20 "
Fayette Sands.	8.	Drab sandy clay becoming gradually the same as No. 8	30 "
	9.	Gray sandstones, coarse grained on top but changing to a fine grained blue stone at base	120 "

careous clayey sands of the Neocene beds and the underlying Fayette sands appear to justify the inference that they form a continuous belt of deposits, somewhat irregular in width and thickness, from west to east and have a general tendency to decrease in areal extent and thickness as we go east.

FAYETTE SANDS.

The gray sandstones as described by Buckley and Loughridge admit of a threefold division and possibly a fourth may be added upon farther examination and investigation, each being represented by beds differing widely from each other, both in lithological structure and faunal character. The uppermost division comprises a series of highly calcareous sands, sandstones and clays containing many water-worn cretaceous shells throughout the sandy portions, but carrying no indigenous invertebrate fauna.[16] Fossil bones have occasionally been reported from these beds and some have been described by Leidy[17] from Washington County and farther west. This division, however, belongs to the Neocene Tertiary. The middle portion, or Frio clays, have already been described, and the Fayette sands proper form the basal portion and probably include the hard silicious sandstones mentioned by Buckley.

The prevailing characteristics of these Fayette sands, as here restricted, are gray sandstones, white and gray clays, and gray sands. The sandstones are irregularly deposited and lie in beds from a few inches to ten, fifteen or twenty feet in thickness. In Jasper County, on the eastern side of the State, these sandstones range from four to ten feet in thickness and at Rockland, in Tyler County, the section shows:[18]

1.	Gray sand	4 feet.
2.	Coarse grained, gray sandstone	5 "
3.	Hard blue sandstone	15 "

Along McManus' Creek, near Stryker, in Polk County, these sandstones form an escarpment for nearly a mile in length and present a solid face of over ten feet, and at Hitchcock's quarry, about a mile north of Corrigan, the sandstones exposed show a thickness of over sixteen feet. Coming westward the thickness becomes less, as near Lovelady, in Houston County, the bedding is from ten inches to two feet. In Grime County the thickness has still farther diminished to from six to eighteen inches. Crossing the Navasota River the bedding begins to thicken to the westward, as a section near Wellborn Station shows them to have a thickness of two to six feet.

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[16] Fourth Annual Report Geol. Survey of Texas, 1893, pp. 9–14 as Navasota Beds.

[17] U. S. G. Survey of the Territories, Vol. I. Extinct Vertebrata, by J. Leidy, p. 246 et seq.

[18] Third Annual Report Geol. Survey of Texas, 1891, p. 120.

In texture these sandstones vary from a soft, indurated sand of scarcely sufficient cohesion to be classed as sandstone to a hard, close grained, glassy quartzite. The different conditions of texture are, however, so intermixed that it would be difficult to specify any distinct area as being prevailingly one or the other. In Jasper County the quartzite conditions appear to prevail in some sections, while at Rockland the rock is coarse grained and hard, but shows no glassy conditions. Again on the Biggam White Headright in the northern portion of Grime County the rocks change from a soft gray color, to a hard gray and brownish-gray sandstone with occasional blocks showing the characteristic texture of quartzite.[19]

The white and gray clays and gray sands associated with these sandstones occur interbedded and interstratified with the sandstone beds and vary in thickness from a few inches to several feet, some of the sand-beds reaching a thickness of twenty-five feet, while the clays rarely exceed six feet. Many of the sands show cross-bedding, some of the beds having a wavy or broken stratification showing the

Corrigan the section of a cutting on the Houston, East and West Texas Railway shows:[20]

1.	Gray sand	3 feet.
2.	Light gray sandstone containing casts of *Corbula alabamensis* Lea, *Dentalium minutistriatum* Gabb, var. *dumbli*, new var., *Venericardia planicosta* Lam., *Cytherea tornadonis* Harris, and *Calyptrophorus velatus* Con.[21]	1½ to 2 "
3.	Durated gray sand or soft sandstone	4 "

The Brazos County section containing fossils occurs at Dr. Williams' quarry about three miles east of Wellborn Station, on the Houston and Texas Central Railway. This section shows:[22]

1.	Gray sands	2 to 8 feet.
2.	Thinly laminated, light gray sandy clays	2 to 8 "
3.	Broken sandstone with fossil casts	2 "
4.	Regular and even bedded sandstone	6 "

Nos. 3 and 4 of this section contain *Bulimella kellogii*; *Pleurotoma* sp.; *Cancellaria penrosii* n. sp., Harris; *Yoldia claibornensis* Conrad; *Mactra* sp.; *Corbula alabamensis* Lea; *Siliqua simondsi* n. sp., Harris; *Venericardia planicosta* Lam.; *Cytherea bastropensis* Harris, and *Turritella* sp.[23]

West of the Brazos River invertebrate fossils have been found in these beds, and from this it may be inferred that the same conditions hold good across the State.

The area occupied by the Fayette beds forms a narrow belt with extremely irregular and as yet badly defined boundaries extending from the bottom lands along the west side of the Sabine, westward to and beyond the Brazos, and while the greatest width of this belt may exceed fifteen miles, yet throughout its greater extent the average width is not over six to eight miles. Their southern margins dip beneath the overlying Frio clays and their northern borders rest upon the gypseous lignite-bearing clays and sands of the Yegua stage. The country underlaid by these sandstones and sands, particularly throughout the eastern portion of the territory in Jasper,

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[20] Third Annual Report Geol. Survey of Texas, 1891, p. 115.

[21] Fourth Annual Report Geol. Survey of Texas, 1892, p. 46.

[22] Harris M.S., Monograph of Texas Tertiary Fossils.

[23] Harris M.S., Monograph of Texas Tertiary fossils.

Tyler and Polk Counties, is broken and hilly and generally rough, many of the hills rising in the form of steep side knobs to elevations more than 150 feet above the level of the river bottoms. The Neches River flows along the northern border of these sandstones for nearly twenty miles before breaking through them near Rockland, and along the whole of this distance the Fayette sands rise almost precipitously from near the river bank to altitudes varying from 120 to 275 feet above the river.

The dip of these beds is gentle, as a whole, but in many places faulting and sliding has obscured the true dip to such an extent that it is difficult to tell its exact rate. Extensive erosion also appears to have taken place throughout the whole area and long narrow projections of the overlying Neocene beds appear in many of the valleys. Along the eastern side of Billum's Creek, about two miles west of Colmesnil, a ridge of brown sand and quartz gravel and coarse pebbles, fifteen feet thick extends in a northeastern direction for several miles.

The Fayette sands of Eastern Texas tie up both stratigraphically and lithologically in the northern portion of Washington County, on the western side of the Brazos with those recently described as occurring from that point westward across the State by Mr. Dumble,[24] and may be considered but an eastern extension of the same.

There can scarcely be any doubt but that these beds, with the Frio clays and overlying Neocene ("Navasota Beds" of the Fourth Annual Report and Dumble's "Oakville Beds"[25]) formed what was under-

Jackson, and a considerable portion of the Claiborne stages are absent throughout the whole of this part of Texas.

Yegua Clays.

Immediately underlying the Fayette sands comes an extensive series of clays and lignites known to the Texas geologists as the Yegua clays. In the First Annual Report of the Survey these clays were considered as forming a portion of the Fayette beds of Prof. Penrose and were by him placed at the base of that division[26] and belonging to the same Grand Gulf series as the overlying gray sandstones of the Fayette sands as now known. The discovery of Eocene fossils in the overlying sandstones as well as in the clays themselves naturally relegated the whole to an older stage of deposition than that to which the Grand Gulf was supposed to belong. The wide lithological variation between the sandstones and thinly stratified and laminated lignitic sands and clays led to the separation of the two into independent stages more in keeping with their structure and evidently widely separated manner of formation and deposition and the designation "Yegua Clays" has been applied to them from their development on the river of that name.

These beds comprise a series of dark blue, brown and gray clays and blue-brown and gray sands and sandy clays. Extensive deposits of lignites are also found throughout the areas occupied by them. The clays are laminated, thinly stratified and massive and characterized by the great quantities of gypsum either in the form of selenite crystals or as irregular masses in a crystalline form distributed throughout the various beds. In the eastern portion of the area the laminated gypseous clays are more prevalent than farther west. In Angelina County these beds are thinly stratified blue clays containing small clusters of minute crystals of gypsum and occasional streaks or pieces of lignite which at their contact with the overlying Fayette sands on the Neches River have a thickness of over thirty-five feet. The section at Clark's Crossing shows:[27]

22.	Gray sandstone stained brown forming base of Fayette sands	3 feet.
23.	Thinly stratified or laminated blue clay with gypsum in crystals, to river level	35 "

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[26] First Annual Report Geol. Survey of Texas, 1889, pp. 47–51.

[27] Third Annual Report Geol. Survey of Texas, 1891, p. 62.

The same characteristics prevail in Houston County where the base comprises a series of blue and brown laminated gypsum-bearing beds showing a section of: [28]

1.	Ferruginous gravel talus from Cook's Mountain.	4 feet.
2.	Thinly laminated brown clays	4 "
3.	Thinly laminated dark blue clays with interlaminæ of brown sand and crystals of selenite.	6 "
4.	Fossiliferous brown sand, containing an extensive fauna, including, among others, *Anomia ephippioides* Gabb; *Volutilithes petrosa* Conrad; *Venericardia planicosta* Lam.; *Calyptrophorus velatus* Conrad, [29] and forming an intermediate bed of the marine stage	10 to 15 "

Towards the western side of the same county these clays give place to massive brown sands and clays containing broken plant remains and sheet-like formations of crystalline gypsum. Still farther west, in Grime and Brazos Counties, gray sand forms the prevailing characteristics.

While towards the eastern end of the area it may be broadly stated that the clays are gypseous throughout and, as in the northern edge of Polk County, the overlying Fayette sands rest upon heavy beds of blue gypseous-clays. The same conditions do not hold good along the contact between these divisions in the western portion. In Houston County, while the gypsum is pretty generally distributed throughout

Brazos Counties than farther east. These are sometimes laminated and crossbedded but the greater portion is structureless. They are often saline, heavy incrustations of salt occupying the beds of dry pools and are of frequent occurrence during the summer months. In places they contain quantities of silicified wood of a dull, lustreless appearance, showing a strong contrast with the beautifully opalized woods of the overlying Fayette sands.

The lignite deposits of this division although well developed at many points are not so extensive, or nearly so regular, as those of the lignitic stage of the earlier Eocene. Most of the deposits range from two to four feet, although from six to ten feet are by no means rare.

Borings through these clays show them to have an aggregate thickness of nearly 1,000 feet. A well at Lamb's Springs, in Grime County, 999 feet deep passed through a series of clays, sands and lignites the whole depth, and another boring at the Agricultural and Mechanical College, five miles south of Bryan, in Brazos County, reached the 900 foot mark before the drill entered the underlying marine beds.

On the Brazos River the contact between the overlying Fayette sands and these clays is seen on the south side of the James Hope Survey in a section showing:

Fayette Sands.	1.	Gray sand and gravel	1 foot.
	2.	Gray sand containing great quantities of silicified wood. The wood is usually in large pieces—four to six feet in length, and bleached white.	5 feet.
	3.	Gray indurated sand with ledges of soft sandstone.	10 "
	4.	Gray sandstone jointed and thinly bedded, forming base of Fayette sands	8 "
Yegua Clays.	5.	Dark brown lignitic clay, showing yellow bands from 1 to ½ inch in thickness and coated with an efflorescence of sulphur, to water	20 "

No. 5 corresponds to the upper brown clay of Prof. Penrose's section of sulphur bluff in this neighborhood and a continuation of the section will give:[30]

6.	Lignite	1 foot.
7.	Gray sand	1 "

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[30] First Annual Report Geol. Survey of Texas, 1889, p. 54–55.

8.	Lignite	½ foot.
9.	Interbedded gray sand and chocolate and greenish clay, turned white in places on the surface	20 feet.

At Jones' bridge, about a mile further up the river, the same greenish clays are found in a section showing:

1.	Yellowish gray sand	32 feet.
2.	Bluish-green, sandy clay containing fragments of lignite and breaking into ovoid blocks	46 "

and still farther up the river numerous shoals are formed of the same bluish-green clay. The section at this place is much obscured by river deposits of a much later age.[31] Here we find:

1.	Brown river loam of sand and fine gravel	18 feet.
2.	Black sandy loam and clay loam mixed with brown sand and containing gravel and a few drift pebbles	2 "
3.	Pale blue clay	8 "
4.	Brown sand	1 foot.
5.	Coarse gravel containing water-worn, cretaceous shells	2 feet.
6.	Soft conglomeratic sandstone	2 to 4 "
7.	Bluish-green lignitic clay, breaking into blocks and containing broken plant remains, extending across the river and forming shoals	6 "

Nos. 4, 5 and 6 of this section do not belong to these Yegua smaller in the upper than the lower beds. Westward from the Neches the gypsum crystals are, however, almost exclusively confined to the fifty or sixty feet at the base.

The base of these clays may be seen in a bluff on the Brazos River about 500 yards south of the mouth of the Little Brazos, with the following section:[32]

	1.	Black soil	2 feet
	2.	Brown loam with limy concretions	25 feet
	3.	Fine brownish-yellow sand with occasional streaks or pockets of gravel	15 feet
	4.	Gravel, with unknown cretaceous shells	2 to 4 feet
Yegua clays	5.	Pale blue clay unfossiliferous	5 feet
	6.	Dark green sand showing fossils in lower portion	2 to 5 feet
Marine Beds.	7.	Dark colored laminated sandy clay containing *Terebra houstonia* Harris; *Levifusus trabeatoides* Harris n. sp.; *Pseudoliva vetusta* var.; *Pseudoliva vetusta* var. *pica*; *P. vetusta*, var. *clausa*; *Trigonarca corbuloides*, Con.; *Pleurotoma* (*Pleurotomella*) *quasites*, Harris; *Nucula magnifica*, Con.; *Leda opulenta*, Con.; *Latirus moorei*, Gabb.; *Corbula alabamensis*, Lea; *Venericardia planicosta*, Lam; *Phos texana*, Gabb., var.; *Natica arata*, Gabb.; *Natica semilunata*, var. *janthinops* new var.; *Sigaretus inconstans*, Ald.; *Yoldia aldrichiana*[33]	4 feet
	8.	Ferruginous sandstones	8 inches
	9.	Same as No. 7.	

In this section the gypseous clays are not seen nor do they appear anywhere in the river banks. This, however, may be expected as their position there is obscured by broad, deep deposits of river alluvium which cover wide areas and form the bottom lands of the Brazos. East of the Little Brazos these clays are found occupying their proper position at several places. A section seen on the line of the Houston and Texas Central Railway near Elm Creek, on the south side of Robertson County, shows:[34]

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[32] Fourth Annual Report Geol. Survey of Texas, 1892, p.

[33] Harris M. S., Monograph of Texas Tertiary Fossils.

[34] Fourth Annual Report Geol. Survey of Texas, 1892, p. 50.

1.	Brownish-yellow sand and gravel	5 to 6 feet
2.	Brown coffee-colored clay with great quantities of gypsum crystals	2 to 6 feet
3.	Brown and yellowish-brown sand and ledges of indurated sand or ferruginous sandstone, the sands containing *Anomia ephippioides,* Gabb; *Plicatula filamentosa* Conrad; *Spirorbis leptostoma,* Swain; *Volutilithes petrosa* Conrad; and other fossils,[35] over	40 feet

Going eastward the Navasota River section is practically the same as on the Brazos. Neocene beds occur a short distance north of Rock Creek, in Grime County. The Frio clays do not appear anywhere along this river, but overlaps of the Neocene Navasota beds (Oakville beds of Dumble) completely cover them. The Fayette sands extend to about the mouth of Gibbon's Creek, or a short distance above, and from there to near the northwest corner of Madison County the whole country is occupied by the gray sands, greenish blue lignitic clays and lignites of the Yegua showing practically the same sections as those found along the Brazos. Very few sections of any value are found along this river, but the few obtainable, supplemented by those farther inland, show the general sequence here given. The gypseous clays are found in this region lying close to the base and occupying the same position as near Elm Creek on the western side of Brazos County.

The Trinity River section shows the typical Yegua clays in many of the bluffs. A section at Hyde's Bluff, in the southwestern portion

The base of these beds is seen at Alabama bluff some twenty miles farther up the river, where a bed of blue clay with gypsum crystals occurs in contact with the underlying fossiliferous sands of the Marine beds. This section shows :[36]

Yegua Clays	1.	Black sandy loam	5 feet
	2.	Gravelly conglomerate	2 feet
	3.	Laminated blue clay with gypsum	2 to 5 feet
Marine Beds	4.	Fossiliferous greenish-blue clay	4 feet
	5.	Green sand	5 feet
	6.	Clay ironstone	10 inches
	7.	Fossiliferous clay, to water	5 feet

No. 3 of this section shows the base of the Yegua clays as found on the Trinity River.

Eastward towards the Neches River the deposits belonging to this stage assume more and more the same structure and conditions of deposition as found in Angelina and the other counties in the eastern portion of the area.

The positions of the sections given show approximately the northern boundary of the area occupied by these Yegua clays. The line may be traced by the outcroppings of the gypseous clays and sands from the Sabine River, near Sabine Town, in a generally northwestern direction as far as the Angelina River, near the mouth of the Atoi Creek, in Cherokee, and thence southwesterly, crossing the Neches near Weches Post Office, passing through the eastern side of the town of Crockett, crossing the Trinity at Alabama Bluff, the Navasota River near the northwest corner of Madison County and the Brazos at the locality shown in the section already given. To the south they are circumscribed by the overlying Fayette sands.

Unlike the rough, hilly region occupied by the Fayette sands, the country occupied by the Yegua clays is generally flat. Sand hills and ridges occur in several localities, but throughout the greater portion level, prairie-like conditions prevail.

The fauna of these deposits throughout east Texas is scanty in the extreme. Of the vertebrates only one specimen, the portion of the lower jaw of a species of *Crocodilus*, has been obtained, and that from a well at Bryan, while no invertebrate fossils have been found anywhere east of the Brazos except at the base of the beds on that river, although the beds found on the Yegua are fossiliferous, and those found farther west are reported to have yielded a very fair number of that class of animal life. Plant remains are numerous, both in the form of silicified and lignitized wood, and leaves of many kinds are extremely abundant. None of these have yet been studied, but from the fact that silicified palm wood occurs, although sparingly, among the upper gray sands, the climate was slightly warmer than at present.

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[36] Third Annual Report Geol. Survey of Texas, 1891, p. 15.

The general conditions of deposition during this period appear to have been those of a marsh subject to periodical deep, wide-spread inundation and a gradual, though slow, subsidence. The Marine beds lying to the north evidently stood at a much higher relative elevation than at present. Their southern boundary is everywhere carved into bold outlines and deeply indented bays showing at places steepsided and shelving bluffs where the Yegua clays rest unconformably upon and against them, and from which boulders of fossiliferous sandstones have fallen and are now found in considerable numbers imbeded in the sands and lying between one and two miles from the line of contact. At other places where bay-like conditions prevailed, the placid waters of the flooded areas favored a calmer deposition and growth of plant life; the lines of contact are not so far apart in their general conditions and range of dip.

Instances of the former conditions are many. Typical illustrations of this bluff-like shore line may be seen at Cook's Mountain, in Houston County, and near Elm Creek, north of Bryan, in and then they corresponded to a lower division of the Moseby Ferry section than those found near Elm Creek. Moreover, on the south prong of Thompson's Creek, about eight miles north of the well boulders and of ferruginous fossiliferous sandstone occur imbedded in the yellowish gray sandy clay of the Yegua beds.

The correlation of any of these three stages—the Frio clays, Fayette sands and Yegua clays—with the deposits of Louisiana lying immediately to the east is attended with more or less difficulty and doubt from the fact that little or no work, and that of the most general character, appears to have been done in that portion of the State. The Grand Gulf, according to both Hilgard and Hopkins, appears to have embraced the upper two and at least a portion of the Yegua clays besides the upper calcareous sandstones, and was, according to these writers, above the Vicksburg. The lower portion of the Yegua clays were apparently considered by them to be of Jackson age. Dr. Hilgard says, after describing the Grand Gulf formation: "On the Sabine River, too, the upper portion of the profile is pretty correctly reproduced. At the base of the Grand Gulf rocks we find on the Bayou Taureau a seam of shell-limestone with Vicksburg fossils. We then pass over lignito-gypseous strata to Sabine Town, Texas, where we see about seventy feet of these overlying ledges of blue fossiliferous limestone alternating every two or three feet with what would be green sand marl like that of Vicksburg had not the lime of the numerous shells, of which it contains casts, been removed by subsequent dissolution. So far as I have seen, the usual leading fossils of Vicksburg are wanting here, while the greater sandiness of the materials, as well as the prevalence of shallow sea bivalves indicates their deposition in shallower water. As we proceed northward from Sabine Town lignitic clays and lignite alone separate, and sometimes altogether replace the limestone ledges which themselves become poorer in fossils as we approach the northern edge of the formation."[37]

According to Hopkins the Jackson beds consist of marine strata with characteristic fossils of lignite and non-fossiliferous beds and laminated sands and clays and among the marine beds massive beds of clay full of selenite.[38]

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[37] Geol. Reconn. of La., American Journal of Science, Second Series, Vol. XLVIII, 1869, p. 338.

[38] First Annual Report Louisiana State Geol. Survey, 1869, pp. 94–96; Second Annual Report Louisiana State Geol. Survey, 1871, pp. 7 to 84.

With the exception of the lignite and characteristic Jackson fossils this description would answer the Texas Frio clays as well as the Yegua clays. Besides their contact with and underlying the Neocene Navasota beds (Oakville beds) would in the absence of the Vicksburg deposits closely correspond with the Frio clays. Their extension to Sabine Town, however, where they would meet the Marine beds of the Texas section would naturally lead to the inference that both the Fayette sands and Yegua clays are absent in Louisiana.

This interpretation of the work done in Louisiana can hardly be accepted, and until more information is obtainable the correlation of the beds in these States must be left as an unsolved problem.

MARINE BEDS.

Lying immediately north of the Yegua clays we have an extensive series of green sands, green sand marls, altered green sands containing thin strata of carbonate of iron, indurated altered fossiliferous greed sand, green fossiliferous clays, glauconitic sandstones and clays stratified, black and gray sandy clays, black and yellow clays with limy concretions, brown and yellow fossiliferous sands with occasional deposits of black sand containing gypsum crystals, and at wide intervals small deposits or thin seams of lignite. Extensive deposits of ferruginous sandstone and limonite, both in laminated and nodular form, occur in the upper divisions. The prevailing deposits, however, are the green sands in their several characters. The clays are of divided into two groups or series, the basal from its greatest development in Cherokee County was called, tentatively, the "Mount Selman" series, and the upper, from its typical development in Houston County, received the name of the "Cook's Mountain" series. This division was made partly on lithological grounds, the lower or Mount Selman series being generally heavier bedded and made up throughout its greater extent of dark green and brown sands and sandstones, with very thin seams of iron and while fossiliferous to a greater or less extent the fossils are much fewer than in the upper or Cook's Mountain series, and exist almost altogether in the form of casts. On the other hand the upper series, which includes the highest beds of the Marine stage, is to a great extent loose sands and clays with heavy beds of laminated iron ore and contains a large and beautifully preserved fauna.

While probably the distinctive lithological differences between the upper and lower divisions of these beds may not hold good at all points and it may be difficult under the present existing conditions to draw the exact line between them yet the general paucity of life in these lower beds appears in marked contrast with the teeming life of the upper.

In the northeastern portion of the State, where in Cass, Marion and Morris Counties, these beds appear only as remnants of a widespread cover, or as isolated patches forming the low hills of the region, nothing but the lower beds are seen. These are brown, brownish-yellow and green in color, indurated and moderately hard sands and sandstones, and have till now shown no trace whatever of animal life. In Harrison County the greenish-yellow sandstones seen near the Marshall waterworks pumping station show occasional casts of *Venericardia planicosta* Lam., and the same form has also been found near Hynson's Springs, in the same county. These lie at the base of the Marine beds as shown in the section at the pumping house.

	1.	Brown gravelly sand	5 feet
Marine	2.	Laminated iron ore and ferruginous sandstone .	1½ feet
	3.	Greenish-yellow altered glauconitic sandstone with casts of *Venericardia planicosta*. . . .	4 feet
Lignitic	4.	Laminated or thinly stratified red and white sands and sandy clays forming uppermost bed of the lignitic in this portion of the county .	45 feet

Coming westward the same unfossiliferous condition of these lower beds is seen along the south side of the Sabine River in Gregg County, in a section at Iron Bridge Post Office. Here the bluff shows:

1.	Surface dark brown or coffee-colored sand with broken fragments of sandstone	6 feet
2.	Heavy bed of yellowish-brown sandstone	6 feet
3.	Brown sand	6 feet
4.	Brown or yellowish-brown sandstone similar to No. 2, but softer and containing alternate strata of brown sand	10 feet
5.	Brown or yellowish-brown sand containing occasional small nodules or concretions of iron	12 feet

In the Mount Selman region, in Cherokee County, the section shown along the line of the Tyler Southeastern Railway is more sand than sandstone, and while containing a few fossil casts cannot be called fossiliferous throughout. The general section shown from Jacksonville to Bullard gives:[40]

1.	Gray surface sand	10 feet
2.	Brown sand, ferruginous pebbles and iron ore	15 feet
3.	Mottled sand	10 feet
4.	Brownish-yellow sand	4 feet
5.	Brownish-yellow standstone	10 feet
6.	Alternate strata of laminated iron ore and brown	

	No.	Stratum	Thickness
	12.	Alternate strata of brown sand and laminated iron ore, one generally wavy and not more than two to six inches with sand from one to two feet thick	20 feet
	13.	Pale-blue and brown clay mottled in places and laminated in others	15 feet
	14.	Alternate strata of glauconitic brown sand and iron ore, the ore generally irregularly deposited, laminated and silicious and not exceeding six inches to one one foot, the sand from six inches to two feet thick	55 feet
	15.	Brown sand forming surface at Bullard, altered green sand changing to yellow a few feet under ground	40 feet
	16.	Dark green sand containing a few fossil shells and fish teeth	24 feet
Lignitic	17.	Lignite or "black dirt" containing leaves	2 feet
	18.	Dark lignitic clay	5 feet

Nos. 17 and 18 of this section belong to the lignitic beds.

On approaching the Brazos the base of these beds is again seen about two miles south of Calvert, in Robertson County, where they form a ridge of brownish-yellow sandstone of very similar texture and appearance as the sandstones in Harrison County, and appear to be altogether unfossiliferous. Where the International and Great Northern Railway crosses the Brazos River these beds are again seen in the following section :

No.	Stratum	Thickness
1.	Yellow sandy clay with limy concretions	20 feet
2.	Brown sand and sandstones interstratified	4 to 6 feet
3.	Dark green, almost black, unfossiliferous sand	5 feet
4.	Thinly laminated dark green sand	6 feet
5.	Irregular belt of ferruginous sandstone	½ to 1 foot
6.	Dark green, almost black, sand, to water	3 feet

The lower and upper divisions grade into each other so imperceptibly that so far as the actual division is lithologically concerned any line of separation would be but a very arbitrary one. The wide distinction, however, in the state of preservation and condition of the contained fossils might possibly enable us to approximately indicate the limits within which the several beds might be assigned to each. As already stated the fossils of the lower or Mount Selman beds exist almost wholly in the form of casts, whereas, on the other hand, the fauna of the Cook's Mountain, or upper beds, is beautifully preserved, many being in a very perfect condition and exist in great numbers.

In crossing the whole series from north to south the first indication of well preserved fossils in the east occurs in the southern portion of Rusk County, near Mount Enterprise, and on Stevens branch, a tributary of Shawnee Creek. Farther west they are found in Cherokee, south of Jacksonville, a few miles west of Palestine, in Anderson, near the mouth of Elkhart Creek, in Houston, near Centreville, in Leon, and south of Franklin, in Robertson County, and near the Burleson County north line on the Brazos. These localities may therefore be taken as approximately indicating the northern line of the "Cook's Mountain" or upper series of the Marine beds as known in Texas, but it must be remembered that on the eastern side very extensive erosion has taken place, and probably these beds may have extended much farther north. At any rate the line may be considered as only an approximate division of what evidently constitutes but one stage of the Eocene.

To the south of this approximate boundary we have an extensive series of green sands, glauconitic sands, ferruginous sandstones, clays and iron ores in most respects similar to those lying north of it. The green sands, as a general thing, are less altered and more glauconitic, the sands less indurated and the iron ore deposits much heavier and almost altogether laminated. The fauna is very much richer both have been identified by Mr. Harris.[42] *Pseudoliva vetusta* Con., *Venericardia planicosta* Lam., have also been obtained from the bluff at Sabine Town. The fossils found in Rusk and Nacogdoches Counties are well preserved and enclosed in a bluish-green indurated marl and hard to extract in a condition suitable for identification. The Sabine Town fossils are enclosed in a brown sand. *Scutella caput-sinensis* Heilpr., also occurs in San Augustine as well as west of the Angelina at McBee's School and near Alto, in Cherokee County.

West of the Angelina River the most important section obtained is that at Alto, in Cherokee County. This section embraces a series of green sands and altered glauconitic sands and sandstones lying close to the top of the "Cook Mountain" beds, and forms the uppermost Eocene deposit in this portion of the State. The section combines the whole of the green sand deposits from Alto, eastward to the edge of the Angelina River "bottom lands," eight or ten miles farther east, and the whole or the greater portion of the section may also be taken as representative of the structure of the country from Alto southwestward to the Neches. The section shows:

1.	Gray sand	5 to 20 feet.
2.	Ferruginous sandstone	1 foot.
3.	Iron pyrites and lignite	½ to 1 foot.
4.	Laminated iron ore and brown sand	10 to 15 feet.
5.	Brown and yellowish-brown altered glauconitic sand with streaks and nodules of calcareous matter and containing *Terebra houstonia* Harris, n. sp., *Pleurotoma* (*Surcula*) *gabbii* Conrad, *Ostrea sellaeformis*, var. *divaricata* Lea, *Pinna*, sp., *Trigonarca pulchra* Gabb, *Pseudoliva vetusta* Con., *Volutilithes petrosa* Con., *Latirus moorei* Gabb, *Corbula texana* Harris, *Corbula aldrichi*, var. *smithvillensis* Harris, *Dentalium minutistriatum* Gabb, *Venericardia planicosta* Lam., *Venericardia rotunda* Lea, *Clavilithes*	

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[42] Harris' MS. Monograph Texas Tertiary fossils.

NOTE.—I have not visited any of the localities referred to in Rusk, Nacogdoches and Sabine Counties. Rusk and Nacogdoches Counties were examined in 1890 by Mr. J. B. Walker. His sections can be seen in the Second Annual Report, Geol. Survey of Texas, 1891, under these county headings. They appear to me to be slightly unreliable. The Sabine Town fossils were sent from there by the Postmaster to Mr. Dumble at his request. K.

regexa Harris, n. sp., *Phos texana* Gabb var., *Distortio septemdentata* Gabb, *Solarium acutum*, var. *meekanum* Gabb, *Terebellum*, *Calyptrophorus velatus* Con., *Mesalia claibornensis* Con., *Anomia ephippioides* Gabb, *Cerithium vinctum* Whitf., *Pecten claibornensis* Conrad, *Pecten deshayesii* Lea, *Plicatula filamentosa* Con., *Cytherea texacola* Harris, *Crassatella texana* Heilp., *Turritella nasuta* Gabb, and many of these in profusion 6

6. Yellowish-brown and grayish-brown often grayish-green indurated green sands containing most of the fossils found in No. 5 and an additional fauna of *Pleurotoma* (*Drillia*) *nodocarinata* Gabb, *Volutilithes petrosa* var. *indenta* Conrad, *Caricella subangulata* var. *cherokeensis* Harris, *Cassidaria brevicostata* Ald., *Pholadomya claibornensis* Ald., *Byssoarca cucullоides* Con., *Martesia texana* Harris, n. sp. *Dentalium minutistriatum* var. *dumblei*, n. var., *Protocardium nicolletti* Con. var., *Natica newtonensis* Ald., *Natica limula* var., *Rimella texana*, var. *plana*, new var. *Cancellaria panones* Harris, n. sp., *Clavilithes* (*Papillina*) *dumosa*, var. *trapaquara* Harris, *C. humerosa*, var. *texana* Harris,

enclosing matrix, those in the brownish-yellow sand being often free.

As already stated these beds can be easily traced from this point in a southwesterly direction for many miles, the bed containing the *Scutella caput-sinensis* forming a particularly well marked horizon. No Scutellæ, however, have yet been found in Houston County or to the west, although plentiful from the Neches eastward to San Augustine. Four miles west of Alto, a range of flat-topped steep-sided hills show a general section of:

1.	Gray sand	20 feet.
2.	Indurated yellow sand containing numerous Scutellæ and *Ostrea sellæformis*, var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Pseudoliva vetusta* Con., *Venericardia planicosta* Lam., and *Cytherea tornadonis* Harris[43]	20 feet.
3.	Red sand with casts of fossils	15 "
4.	Green sand with casts of fossils visible	4 "

Crossing the Niches into Houston County the section as shown in a well near Robbins' Ferry shows:

1.	Gray sand	6 inches to 1 foot.
2.	Laminated iron ore	4 inches to 10 inches.
3.	Indurated yellow fossiliferous sandy marl containing *Ancilla* (*Olivula*) *staminea* Con., *Ostrea sellæformis*, var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Venericardia planicosta* Lam., and *Crassatella trapaquara* Harris[44]	2 feet.
4.	Yellow sand	10 "
5.	Clay	2½ "
6.	Fossiliferous green sandy clay containing *Anomia ephippioides* Gabb, *Venericardia planicosta* Lam., *Rimella texana*, var. *plana*, new variety, *Calyptrophorus velatus* Con.[45]	5 to 6 "
7.	Red clay	3 to 4 "
8.	Blue marl with fossils same as No. 6	18 "
9.	Brown sand to bottom of well	5 "

At the crossing of the San Pedro Creek by the Rusk road in the same county, the south bank of the creek shows a section of

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[43] Harris, MSS., Monograph of Texas Tertiary Fossils.
[44] Harris Mss. Monograph of Texas Tertiary fossils.
[45] First Annual Report Geol. Survey of Texas, 1889, p. 34.

1. Gray sands . . . . 25 feet
2. Brown sand and altered green sand with stratified ferruginous material and thin laminæ of iron ore near base . . . . 6 feet
4. Yellow indurated fossiliferous altered green sand packed with shells . . . . 20 feet

The eastern portion of Hurricane Bayou forms the approximate southern boundary of the Marine beds for six or eight miles east of Crockett. Here, when the Bayou is dry, or the water at a low stage, an extremely interesting fauna may readily be obtained. Among the fossils found we have *Terebra texagyra* Harris var., *T. houstonia* Harris n. sp., *Conus sauridens* Con., *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl. heilpriniana* H. n. sp., *Pl.* (*Drillia*) *nodocarinata* Gabb., *Pl. childreni* Lea, var. *bilota*, H., *Pl. huppertzi* Harris, n. sp. *Pl. megapis* H. n. sp., *Pl.* (*Drillia*) *texacona* Harris, *Pl.* (*Drillia*) *texana* Gabb., *Pl. vaughani* var. Harris, *Pl. retefera* H., *Pl.* (*Mangellia*) *infans* var. H., Mr. *Olivella bombylis* var. *burlesonia* H., *Ancilla* (*Olivula*) *staminea* Con., *Anomia ephippioides* Gabb., *Plicatula filamentosa* Con., *Pecten* sp., *Pinna* sp., *Pectunculus idoneus* Con., *Pseudoliva vetusta* Con. var., *Volutilithes petrosa* Con., *Caricella demissa* var. *texana* Gabb., *Marginella seminoides* Gabb., *Lapparia pactilis* var. *mooreana* Gabb., *Turricula* (*Conomitra*) *texana* H., *Terebra amœna* Con., *T. costata* Lea, var., *Latirus moorei* Gabb., *Corbula alabamensis* Lea, *Dentalium minutistriatum* Gabb., *Cadulus subcoarcuatus* Gabb., *Venericardia rotunda* Lea, *V. planicosta* Lam., *Crassatella texana* H., *Cytherea tornadonis* H., *Clavilithes* (*Papillina*) *dumosa* var. H., *C. trapaquara* H., *Fusus mortoni* var. *mortonopsis* Gabb, *Clavilithes humerosa* var. *texana* H., *Phos texana* Gabb var., seen in a well at Mr. K. Jones' house, nearly half a mile north of the Bayou. The section of the well shows:

1.	Yellowish-brown sandy clay	6 feet
2.	Joint clay	6 feet
3.	Thinly laminated black fossiliferous sand	4 feet
4.	Bluish green fossiliferous sands	14 feet

Nos. 3 and 4 hold fossils closely corresponding to those found on the Bayou with a few additional species.

West of Crockett, about two miles, we have Cook's Mountain, an isolated hill rising about 460 feet above sea level and showing a more or less precipitous face on every side. This face, however, is marked by a series of benches and the general section shown on the eastern side, from Milam branch to the top of the mountain, shows:

1.	Brown ferruginous sandstone with occasional casts of a small bivalve	10 feet
2.	Yellow-colored crossbedded altered glauconitic sand	40 feet
3.	Brown sand and sandstone with occasional seams of ferruginous material	55 feet
4.	Brown ferruginous sandstone containing *Ostrea sellæformis* var. *divaricata* Lea, and *O. alabamensis* Lea in considerable numbers	10 feet
5.	Iron ore	1 foot
6.	Brown sand containing *Bulimella kellogii* Gabb., *Terebra texagyra* var. Harris, *T. houstonia* Harris, n. sp., *Conus sauridens* Con., *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl.* (*Cochlespira*) *engonata* Con., *Pl.* (*Drillia*) *nodocarinata* Gabb., *Pl.* (*Drillia*) *texana* var. *pleboides* Harris, *Pl.* (*Mangelia*) *infans* var., *Pl.* sp., *Ancilla* (*Olivella*) *staminea* Con., *Ostrea alabamensis* Lea, *O. sellæformis* var. *divaricata* Lea, *Anomia ephippioides* Gabb., *Plicatula filamentosa* Con., *Avicula* sp., *Pinna* sp., *Pseudoliva vetusta* Con. var., *Volutilithes petrosa* Con., *V. petrosa*, var. *indenta* Con., *V. precursor* Dall. var., *Caricella subangulata* var. *cherokeensis* Harris, *Lapparia pactilis* var. *mooreana* Gabb., *Latirus moorei* Gabb.; *Cornulina armigera* Con., *Corbula alabamensis* Lea,	

Venericardia planicosta Lam., *Cytherea texacola* Harris, *Clavilithes regexa* Harris, n. sp., *Phos texana* Gabb. var., *Distortio septemdentata* Gabb., *Scala*, *Natica arata* Gabb., *N. limula* var., *Sigaretus declivis* Con., *Calyptrophorus velatus* Con. *Turritella nasuta* var. *houstonia* Harris, *T. nasuta* Gabb., *Belosepia ungula* Gabb., and the corals *Oculina* Heilpr., *Turbinolia pharetra* Lea, *Trochosmilia mortoni* Gabb and Horn, and *Endopachys maclurii* Lea. A number of fish teeth also occur in this bed . . 15 feet

Going north from the Hurricane Bayou localities we find fossiliferous indurated brownish-yellow and green marly sands at Hannon's mill, and on the Murchison prairie and eastward. A section of Murchison prairie shows:

1. Black soil . . . . 1 to 2 feet
2. Brownish-yellow altered green sand . . . . . . 4 feet
3. Brown sand containing *Ostrea alabamensis* Lea, *Ostrea selleformis* var. *divaricata* Lea, *Pecten deshayesii* Lea, *Cerithium vinctum* Whitf., *Venericardia alticosta* var. *perantiqua* Con., *Venericardia planicosta* Lam., and *Cytherea texacola* Harris, *Volutilithes petrosa* var. *indenta* Con., *Cornulina armigera* Con . . . . 4 feet
4. Bluish green marly sand indurated and containing similar fossils to No. 3, as well as *Corbula aldrichi* var. *smithvillensis* Harris, *Crassatella texana* Heilpr., *Crassatella trapaquara* Harris, and

and other fossils similar to those occurring in the dark green sand and greenish black clay as seen in the Jones' well near Hurricane Bayou, where it has a known thickness of fourteen feet. Brown clays with pebbles occur near Hague's gin four miles northeast of Jones' well, and gray and bluish yellow clays with calcareous nodules can be traced as far south as the same place where they have a thickness of five feet and are underlaid by the same brown sand, five to six feet thick, as found in No. 3 of the Elkhart section.

On the Trinity River we have the section well exposed in a series of bluffs extending from Alabama Bluff on the south to the northern edge of Houston County. The section at Alabama Bluff gives the contact with the overlying Yegua clays and shows a slight unconformability between the two stages. Omitting the upper portion of the section we have:

4. Fossiliferous greenish-blue clay . . . . 4 feet.
5. Green sand altered to a brownish-yellow sand with thin strata of ferruginous material interstratified and containing *Volvula conradiana* Gabb, *Conus sauridens* Conrad, *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl.* (*Cochlespira*) *engonata* Con., *Pl.* (*Surcula*) *moorei* Gabb, *Pl.* (*Drillia*) *nodocarinata* Gabb, *Pl.* sp., *Ancilla* (*Olivula*) *staminea* Con., *Anomia ephippioides* Gabb, *Plicatula filamentosa* Con., *Trigonarca pulchra* Gabb, *T. corbuloides* Con., *Leda houstonia* Harris, *Pseudoliva vetusta* Con. var., *Volutilithes petrosa* Con., *Caricella demissa*, var. *texana* Gabb, *Turricula* (*Conomitra*) *texana* Harris, *T. polita* Gabb, *Latirus moorei* Gabb, *Corbula alabamensis* Lea, *Cadulus sub-coarcuatus* Gabb, *Fusus mortoni*, var. *mortonopsis* Gabb, *Clavilithes penrosei* Heilprin, *Phos texana* Gabb, *Distortio septemdentata* Gabb, *Cassidaria planotecta* Ald., *Solarium bellastriatum* Con., *Natica arata* Gabb, *N. limula* Con., *Mesalia claibornensis* Con., *Turritella nasuta* Con., *Spirorbis leptostoma* Swain, *Turbinolia pharetra* Lea . . . 5 to 6 feet.
6. Ferruginous sandstone with iron-ore . . . . 1 to 2 "
7. Green sand and ferruginous material same as No.

5 and containing same fossils with addition of *Pleurotoma heilpriniana* Harris, n. sp., *Ostrea sellæformis*, var. *divaricata* Lea, *Pinna*, sp., *Byssoarca cuculloides* Con., *Lapparia pactilis*, var. *mooreana* Gabb, *Venericardia planicosta* Lam., *Crassatella texana* Harris, *Cytherea texacola* Harris, *Clavilithes* (*Papillina*) *dumosa*, var. *trapaquara* Harris, *Natica* sp., *Turritella nasuta*, var. *houstonia* Harris, *Belosepia ungula* Gabb, *Euphyla trapaquara* Harris.[46]	4 feet.

Going north from here the next bluff is known as Brookfield's Bluff, six miles north of Alabama. No fossils were obtained here and the bluff presents a section of:

1.	Sand and gravel	20 feet.
2.	Brown sandstone in heavy bed	10 "
3.	Clay ironstone	1 foot.
4.	Laminated dark blue sand and light gray clays with iron pyrites	8 feet.
5.	Lignite	2 inches.
6.	Same as No. 4	5 feet.
7.	Thin seam of ferruginous sandstone	6 inches.
8.	Same as No. 4, getting darker in lower portion of the beds and covered in places with a yellow efflorescence of sulphur. Water issuing from these beds is sulphurous and the springs show	

8.	Dark greensand, weathering brown, containing fish teeth but not invertebrates	6 feet.
9.	Brown sand	4 "

At Wooter's Bluff, six miles farther north, the beds are also found to be unfossiliferous although the higher grounds lying at some distance away from the river show brown sandstones and altered green sands with few fossils. The section at the bluff appears to be more of a lignitic nature towards the base.

1.	Brown and yellowish-brown sand	10 to 15 feet.
2.	Clay ironstone	1 to 3 inches.
3.	Dark gray micaceous clay, weathering brown on outside	20 feet.
4.	Clay ironstone	1 to 2 inches.
5.	Dark blue or bluish-black micaceous clayey sand	2 to 6 feet.

About a mile and a half east of this bluff the yellowish clay with limy nodules seen at Elkhart and at Hagues gins occurs immediately below a heavy deposit of yellowish-gray sand.

Crossing the Trinity and going west the "red lands" of Leon County closely correspond in texture and faunal life with the beds of Houston County on the east and the beds found in the northwest corner of Madison County and the Wheelock prairie region. In fact southwest Leon forms but an extension of the Madison and Robertson County beds. A section at the northwest corner of Madison may be taken as a type of these "red lands." This section shows:

1.	Brown sand, gravel and conglomerate boulders	20 feet.
2.	Brownish-yellow sand containing *Conus sauridens* Con., *Pleurotoma*, sp., *Ostrea sellæformis*, var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Plicatula filamentosa* Con., *Pseudoliva vetusta* Con., var., *Corbula alabamensis* Lea, *Venericardia planicosta* Lam., *Clavilithes humerosa*, var. *texana* Harris, *Cerithium vinctum* Whitf. and *Mesalia claibornensis* Con.	2 feet.
3.	Fossiliferous sandstone containing a portion of these fossils	1 foot.
4.	Brown sand	-

Cedar Creek, near Wheelock lies nine miles west of this point and it was from that place the fossils described by Gabb were obtained. In the list of species described by that writer we find *Belosepia ungula* Gabb, *Murex* (*Odontopolys*) *compsorhytis* Gabb, *Fusus mortonopsis* Gabb, *Neptunea enterogramma* Gabb, *Pleurotoma, Turris kellogii* Gabb, *T. texana* Gabb, *T. retifera* Gabb, *T. nodocarinata* Gabb, *Eucheilodon reticulata* Gabb, *Scobinella crassiplicata* Gabb, *S. leviplicata* Gabb, *Distortio septemdentata* Gabb, *Phos texana* Gabb, *Pseudoliva fusiformis* Con. mss., *P. linosa* Con., mss., *P. carinata* Con. mss., *P. perspectiva* Con. Mss., *Gastridium vetustum* Con., *Agaronia punctulifera* Gabb, *Fasciolaria moorei* Gabb, *Cymbiola texana* Gabb, *Mitra mooreana* Gabb, *M. exilis* Gabb, *Erato semenoides* Gabb, *Neverita arata* Gabb, *Monoptygma crassiplica* Con. Mss., *Architectonica meekana* Gabb, *Spirorbis leptostoma* Swain, *Turritella nasuta* Gabb, *Dentalium minutistriatum* Gabb, *Ditrupa subcoarcuata* Gabb, *Bulla kellogii* Gabb, *Volvula conradiana* Gabb, *Corbula texana* Gabb, *Cibota mississippiensis* Con., *Anomia ephippioides* Gabb.[47]

The whole, or nearly the whole of these species have been obtained by the Texas Survey during the course of the work in that region, and several others have been added to the above list.

The section shown on Cedar Creek and in the immediate vicinity is as follows:

1. Brown prairie sandy soil with occasional blocks or fragments of ferruginous sandstone containing great quantities of *Plicatula filamentosa* Gabb, and *Spirorbis leptostoma* Swain . . . . . . 5–15 feet.
2. Brown altered green sand and clay . . . . . . 4 "
3. Thin seam of ferruginous sandstone . . . . . 1 foot.

Nos. 2 and 3 contain quite an extensive fauna comprising

P. vetusta, var. *fusiformis* Lea, *Ostrea alabamensis* Lea, *O. sellaeformis*, var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Plicatula filamentosa* Conrad, *Byssoarca cuculloides* Con., *Trigonarca pulchra* Gabb, *T. corbuloides* Con., *Nucula magnifica* Con., *Leda opulenta* Con., *Yoldia claibornensis* Conrad, *Marginella semen* Lea, *Volutilithes petrosa* Con., *V. precursor* Dall, *V. dalli* Harris, n. sp., *Turricula polita* Gabb, *Latirus moorei* Gabb, *Cornulina armigera* Gabb, *Pteropsis conradi* Dana, *Corbula aldrichi*, var. *smithvillensis* Harris, *C. texana* Gabb, *C. alabamensis* Lea, *Dentalium minutistriatum* Gabb, *Dentalium minutistriatum* Gabb, var. *dumblei*, n. var., *Venericardia planicosta* Lam, *Cytherea tornadonis* Harris, *C. bastropensis* Harris, *Fusus mortoni* var. *mortonopsis* Gabb, *Phos texana* Gabb var., *Distortio septemdentata* Gabb, *Tuba antiquata*, var. *texana* n. var., *Solarium scrobiculatum* Con., *S. vespertinum* Gabb, *Natica arata* Gabb, *N. limula* Con., *N. semilunata*, var. *janthinops* n. var., *Sigaretus inconstans* Ald., *S. declivis* Con., *Pyrula* (*Fusoficula*) Ald., *P.* (*Fusoficula*) *penita* Con., var., *Mesalia claibornensis* Con., *Turritella nasuta* Gabb, *T. dumblei* Harris n. sp., *Aturia*, near *zic zac*. *Belosepia ungula* Gabb, *Flabellum* sp., *Turbinolia pharetra* Lea and *Lunulites* sp.

4. Pale to purplish-pink clay found 200 yards farther down Cedar Creek than No. 3. Very few fossils found in this bed . . . 4 to 6 feet.

5. Dark grayish-green sand containing, in addition to the greater number of the fossils found in No. 2, the following: *Pleurotoma childreni*, var. *bilota* Harris, *Cancellaria panones*, var. *junipera* Harris, *Cancellaria gemmata* Con., *Volutilithes petrosa*, var. *indenta* Con., *Cadulus sub-coarcuatus* Gabb, *Chrysodomus enterogramma* Gabb and *Solarium acutum*, var. *meekanum* Gabb 4 "

6. Green sand with laminæ of clay containing nearly the same fauna as in Nos. 3 and 5 with *Actæon punctatus* Lea and *Pl. retifera* Gabb,[*] additional . . . . 4 to 6 "

7. Dark brown and purplish-brown sand and

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[*] Harris Ms.

clay, laminated with fossils in sand, to bed of creek . . . . 2 fe

The next section west of this is on Campbell's Creek, near Dum ranch and about six miles west of Wheelock. This shows:

1. Black soil . . . . 2 to 4 fe
2. Brown sand with calcareous material . . . 4 to 8 '
3. Ferruginous brown sandstone and sands, altered green sands with *Conus sauridens* Con., *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl.* (*Drillia*) *nodocarinata* Gabb, *Pl.* (*Borsonia*) *plenta* Harris, *Ancilla* (*Olivula*) *staminea* Con., *Ostrea sellæformis*, var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Nucula magnifica* Con., *Pseudoliva vetusta* Con., var., *P. vetusta*, var. *fusiformis* Lea, *Volutilithes petrosa*, var. *indenta* Con., *V. precursor* Dall, *Latirus moorei* Gabb, *Corbula texana* Gabb, *Venericardia planicosta* Lam., *Fusus mortoni*, var. *mortonopsis* Gabb, *Phos texana* Gabb, var., *Distortio septemdentata* Gabb, *Sigaretus declivis* Con., *Mesalia claibornensis* Con., *Turritella nasuta* Gabb, *Turritella dumblei* Harris n. sp., *Belosepia ungula* Gabb . . . . 4 fee

	in No. 4 *Ancilla ancillops* Heilpr., *Byssoarca cuculloides* Con., *Pseudoliva vetusta* var. *fusiformis* Lea, *Volutilithes precursor* Dall., *Cornulina armigera* Con., *Corbula aldrichi*, var. *smithvillensis* Harris, *C. texana* Gabb, *Dentalium minutistriatum* Gabb, *Fusus mortoni*, var. *mortonopsis* Gabb, *Phos texana* Gabb, *Distortio septemdentata* Gabb, *Solarium scrobiculatum* Con., *S. acutum*, var. *meekanum* Gabb, *Pyrula* (*Fusoficula*) *texana* Ald., *Mesalia claibornensis* Con., *Turritella nasuta* Gabb-[49] . .	1 foot.
6.	Laminated fossiliferous blue clay	10 feet.
7.	Alternate strata of yellowish sand and blue clay, clay 6 inches and sand from 4 to 8 inches thick	4 "
8.	Brown sand	1½ "

The connection between these beds will be readily understood when it is stated that at least 30 of the 38 species found at Campbell's Creek are common to Wheelock and the exact stratigraphic position of the two sections can be seen in a section on the Town branch, south of the town of Wheelock and intermediate between the Cedar Creek and Campbell's Creek sections. Out of some 36 species obtained 19 are common to Campbell's Creek, 26 to Cedar Creek and the following 10 do not occur at either: *Pleurotoma* (*Drillia*) *texana* Gabb, *Pl.* (*Drillia*) *pleboides* Harris, *Pl.* (*Mangelia*) *infans* var. Mr., *Pl.* (*Scobinella*) *crassiplicata* Gabb, *Turricula* (*Conomitra*) *texana* Harris, *Terebra amœna* Con., *Periploma collardi* Harris n. sp., *Clavilithes humerosa*, var. *texana* Harris, *Clavilithes* (*Papillina*) *dumosa*, var. *trapaquara* Harris, and *Caricella subangulata*, var. *cherokeensis* Harris.[50]

The section shown at this place is:

1.	Black surface soil	1 to 3 feet.
2.	Dark-brown gypseous clay, base of the Yegua stage	1½ "
3.	Brown fossiliferous sandstone and brown clay	

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[49] Harris Mss.

[50] Harris Mss.

	interstratified and containing the above fossils	3 "
4.	Blue laminated clay in which no fossils were found, to bed of stream	2 "

Small sections of a similar character occur on Elm Creek, near Burckley Station and on the Wilson Reid Headright, both lying between Campbell's Creek and the Brazos River.

Along the Brazos we have probably the most important and most complete section of these beds. To the south we find them passing beneath the Yegua clays about 500 yards south of the mouth of the Little Brazos. Thence throughout a succession of bluffs we can trace the Marine beds northward to their contact with the underlying lignitic a short distance north of International Railway bridge, a direct distance of twelve miles. The section showing the contact between the Yegua clays and the Marine beds has already been given, and the next section, that on the Little Brazos, near the iron bridge, on the Moseley's Ferry and Bryan road shows:

1.	Chocolate brown clayey soil, river deposits .	10 to 15 feet.
2.	Gravel	2 to 4 "
3.	Laminated unfossiliferous clay	4 "
4.	Pale blue unfossiliferous clay	1 to 3 "
5.	Thinly laminated blue to black colored clay containing *Terebra houstonia*, Harris, *Terebra texagyra* var. Harris, *Conus*	

minutistriatum var. *dumblei* Harris, n. var. *Venericardia planicosta* Lam., *Distortio septemdentata* Gabb, *Solarium alveatum* Con., *S. vespertinum* Gabb, *Phos texana* Gabb, var. *Chrysodomus parbrazana* Harris, n. sp., *Natica arata* Gabb, *N. semilunata* var. *janthinops* Harris, *Pyrula* (*Fusoficula*) *texana* Ald., *Turritella nasuta* Gabb, *Turritella dumblei* Harris, n. sp.[51]

6. Fossiliferous iron ore . . . . 1 foot.
7. Fossiliferous green clay containing most of the fossils found in No. 5 with *Atys*. *Bulimella kellogii* Gabb, *Pleurotoma* (*Cochlespira*) *engonata*, Con., *Pl. childreni* Lea, var. *bilota* Harris, *Pl. retifera* *Pl.* (*Mangelia*) *infans* var. Mr., *Cancillaria tortiplica* Con., *C. panonis* var. *smithvillensis* Harris, *Byssoarca cuculloides* Con., *Turnicula polita* Gabb, *Corbula alabamensis* Lea, *Cadulus sub-coarcuatus* Gabb, *Pyramidella preexilis* Con., var., *Solarium acutum* var. *meekanum* Harris, *Meslia Claibornensis* Con., *Terebra texagyra* n. sp. var. Harris.[52]

The next section is shown at Moseley's Ferry on the Brazos. This is the section referred to by Dr. Ferdinand Roemur as being visited by him in 1847 and which he characterized as "consisting of alternate strata of brown ferruginous sandstones and of dark colored plastic clays, both teeming with fossils."[22] The bluff here extends along the river a distance of about 1,500 feet and is from 25 to 30 feet high. With the exception of the upper 15 feet of brown sand it is fossiliferous throughout. The fossils are very well preserved, exceedingly plentiful and easily obtained. The dip of the beds as shown in this bluff is between 50 and 55 feet per mile, but it may be said that throughout this region as well as other portions of the older Eocene reliable dips are very hard to obtain.

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[51] Harris MSS.
[52] Am. J. of Sci. Vol. vi, Second series, 1848, p. 23.

Section at Moseley's Ferry, Brazos River :—

1.	Brownish yellow surface loam	15 feet.
2.	Thin stratum of fossiliferous iron ore in boulder form	6 inches.
3.	Blue laminated fossiliferous clay	3 feet.
4.	Fossiliferous iron ore, running under the river about 100 yards below the ferry	2 "

Nos. 2, 3 and 4 contain an extensive fauna, comprising *Levifusus trabeatoides* Harris, n. sp., *Conus sauridens* Con., in great numbers, *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl.* (*Cochlespira*) *engonata* Con., *Pl.* (*Drillia*) *nodocarinata* Gabb, *Pl. terebriformis* Mr., *Pl.* (*Borsonia*) *plenta* Harris, *Ostrea sellæformis* var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Byssoarca cuculloides* Lea, *Pseudoliva vetusta* var. *Volutilithes petrosa* Con., *Volutilithes precursor* Dall., *Turricula polita* Gabb, *Latirus moorei* Gabb, *Corbula texana* Gabb, *Dentalium minutistriatum* Gabb, *Dentalium minutistriatum* var. *dumblei* new variety, *Venericardia planicosta* Lam., *Cytherea texacola* Harris, *Cytherea tornadonis* Harris, *Chrysodomus enterogramma* Gabb, *Phos texana* Gabb, var., *Distortio septemdentata* Gabb, *Tuba antiquata* var., *antiqua* new var., *Solarium acutum* var. *Meekanum* Gabb, *Sigaretus declivis* Con., *Mesalia claibornensis* Con., *Turritella nasuta* Con., *T. dumblei* Harris, n. sp., *Pyrula* (*Fusoficula*) *texana* Ald., and several corals.[53]

5.	Laminated fossiliferous blue clay containing *Conus sauridens* Con., *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl.* (*Cochlespira*) *engonata* Con., *Pl.* (*Borsonia*) *plenta* Harris, *Pl.* (*Surcula*) *moorei* var. *Levifusus trabeatoides* Harris n. sp., *Ancilla* (*Olivula*) *staminea* Con., *Pseudoliva vetusta* var., *Volutilithes petrosa* Con., *Dentalium minutistriatum* Gabb, *Venericardia planicosta* Lam., *Leda opulenta* Con., *Cytherea texacola* Harris, *Distortio septemdentata* Gabb, *Mesalia claibornensis* Con., *Turritella nasuta* Fabb and *Belosepia ungula* Gabb	6 feet.

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[53] Numbers 2, 3 and 4 are marked A in Mr. Harris' lists; No. 5, B; Nos. 6, 7 and 8, C; No. 9, D; No. 10, E; Nos. 11, 12 and 13, F.

6. Fossiliferous iron ore . . . . 2 feet.
7. Altered fossiliferous green sand found at north end of bluff . . . . 10 "
8. Fossiliferous iron ore . . . . 2 "

Nos. 6, 7 and 8 contain *Conus sauridens* Con., *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl.* (*Drillia*) *nodocarinata* Gabb, *Pl.* (*Borsonia*) *plenta* Harris, *Levifusus trabeatoides* Harris n. sp., *Anomia ephippioides* Gabb, *Pseudoliva vetusta* Con. var., *Latirus moorei* Gabb, *Venericardia planicosta* Lam., *Distortio septemdentata* Gabb, *Turritella dumblei* Harris n. sp., *Byssoarca cuculloides* Con., *Solarium acutum*, var. *meekanum* Gabb.

9. Green sand, dark green near ferry, but altering to a brown near north end, and merging into No. 7, measuring at ferry . 5 feet.

This bed contains *Conus sauridens* Con., *Pleurotoma* (*Surcula*) *gabbii* Con., *Ancilla* (*Olivula*) *staminea* Con., *Ostrea sellaeformis*, var. *divaricata* Lea, *Anomia ephippioides* Gabb, *Pseudoliva vetusta* Con., var., *P. vetusta*, var. *carinata* Con., *Pteropsis conradi* Dana, *Corbula texana* Gabb, *Venericardia planicosta* Lam., *Cytherea texacola* Harris, *Fusus mortoni*, var. *mortonopsis* Gabb, *Phos texana* Gabb, var. *Distortio septemdentata* Gabb, *Turritella nasuta* Gabb, and *Tenuiscola trapaquara* Harris n. sp.,[54] *Turbinolia pharetra* Lea, *Endopachys maclurei* Lea and other corals.

10. Thinly laminated blue clay, changing into brown near top, and weathering to a light blue toward the bottom; the upper brown portion contains fossils similar to those in No. 9, and the lower blue contains occasional crystals of selenite . . . . 15 feet.
11. Dark, almost black, fossiliferous sandy clay . 10 "
12. Thin seam of black clayey sand, jointed and stained brown along joints and on outside, apparently unfossiliferous . . . . 1 foot.
13. Same as No. 11, extending into river and forming a ledge in bottom of river . . . 14 feet.

Nos. 11 and 13 contain *Pleurotoma childreni* Lea, var. *bilota* Harris, *Yoldia claibornensis* Ald., *Pseudoliva vetusta* Con., var.,

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[54] Harris Mss.

Tellina mooreana Gabb, *Venericardia planicosta* Lam., *Cytherea bastropensis* Harris, *Turritella nasuta* Gabb.

The section next seen is at Niblett shoals, about a mile and a half north of Mosley's Ferry. This section shows a decided change in which we find from 12 to 14 feet of lignitic shales, sands and lignites lying beneath in 20 feet of river loam.

The next section is at Collard's Ferry, four miles north of Mosley's. This section has been described by Dr. Penrose as the Burleson shell bluff,[55] there being no ferry at this place when visited by Penrose. The section here given is essentially the same as given by him, the only difference being the division of the upper twenty feet of fossiliferous green sand. The section shows:

1.	Brown sand	10 feet.
2.	Indurated brown altered green sand . . .	8 inches.
3.	Brownish-green altered green sand	4 to 6 feet.
4.	Grayish-green sand	10 to 15 feet.

Nos. 3 and 4 of the section contain *Pleurotoma* (*Surcula*) *gabbii* Con., *Pl. childreni* Lea, var. *bilota* Harris, *Cancellaria minuta* Harris, *Olivella bombylis*, var. *burlesonia* Harris n. var., *Ostrea sellæformis*, var. *divaricata* Lea, *Plicatula filamentosa* Conrad, *Pecten deshayesii* Lea, *Pinna* sp., *Byssoarca cucculloides* Conrad, *Leda opulenta* Con., *Pseudoliva vetusta* Con., variety *Volutilithes petrosa*, var. *indenta* Con., *Lapparia pactilis*, var. *mooreana* Gabb, *Latirus moorei* Gabb, *Corbula aldrichi*, var. *smithvillensis* Harris, *Dentalium minutistriatum* Gabb, *D. minutistriatum*, var. *dumblei* Harris n. var., *Venericardia rotunda* Lea, *V. alticostata*, var. *perantiqua* Con., *V. planicosta* Lam., *Cytherea* sp., *C. texacola* Harris, *C. bastropensis* Harris, *Clavilithes* (*Papillina*) *dumosa*, var. *trapaquara* Harris, *Fusus mortoni*, var. *mortonopsis* Gabb, *Clavilithes penrosei* Heilprin, *C. humerosa*, var. *texana* Harris, *Pleurotoma* (*Clathurella*) *fannæ* Harris n. sp., *Solarium scrobiculatum* Con., *S. alveatum* Con., *Natica semilunata*, var. *janthinops* Harris n. var., *N. newtonensis* Ald., *Sigaretus declivis* Con., *Pyrula* (*Fusoficula*) *penita* Con. var., *Rimella texana* Harris n. sp., *R. texana*, var. *plana* Harris n. var., *Calyptrophorus velatus* Conrad, *Turritella*, sp., *Belosepia ungula* Gabb, *Trochita*, sp. and corals *Turbinolia pharetra* Lea.

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[55] First Annual Report Geol. Survey of Texas, 1889, p. 27.

5. Dark blue laminated clay	6 to 8 feet
6. Brown coal in river	4 feet

This bluff extends up the river for nearly a mile and is from twenty to twenty-five feet high. The fossils are plentiful and well preserved, although not so easily obtained as at Moseley's Ferry. *Pecten deshayesii* is particularly plentiful, in some portions forming solid masses from four to six inches thick for considerable distances.

From here to the base of the beds at the railway bridge no fossils have been obtained.

The similarity of the structure of these beds and their contained fauna from the Angelina River on the east to the Brazos on the west, as well as the several isolated exposures lying in the counties east of the former, mark a continuity extending clear across east Texas. These beds are also well marked to the west of the Brazos and at Smithville, on the Colorado, we find another great assemblage of fossils, the greater number of which are identical with those found on the Brazos and Wheelock. It may, however, be remarked that so far as numbers of several of the specimens are concerned many of the species show considerable differences. Thus, *Conus sauridens*, although scarcely represented at any locality east of the Trinity becomes very prolific at Moseley's Ferry, on the Brazos. The same may also be said of *Pecten deshayesii*, which, though numerous at Collier's Ferry on that river is scarce in the east. On the other hand *Plicatula filamentosa* and *Spirorbis leptostoma* are abundant in Hurricane Bayou and at Alabama Bluff, although extremely few of these have been obtained anywhere else.

The correlation of these beds with the Lisbon stage of the Lower Claiborne of the Alabama section appears to rest upon several grounds. First, their stratigraphic position. In both States they rest upon the lignitic. It is true the Buhrstone of the Alabama section intervening between the Lisbon and Lignitic is absent in Texas. Both comprise a series of highly fossiliferous sandy and clayey strata with glauconitic green sand and sands containing streaks and nodules of calcareous matter, much of which is badly weathered. Some of the beds are indurated into hard ledges of brown or yellow sandstones, but brownish-greenish and bluish-green soft sands and plastic clays form the great bulk of the deposits. The presence of small beds and deposits of lignite and lignitic strata at irregular intervals in the Texas beds marks the most prominent difference between these beds and Lower Claiborne of Alabama. The presence of these lignitic strata in the Texas beds and their absence in Alabama appears to show a difference in the conditiohs of deposition in the two localities. The lignitic is essentially a marsh production, while the others belong to a coastal marine, or at least comparatively shallow sea, and the occurrence of the two in connection with each other would lead to the inference that while a steady marine condition of affairs continued in Alabama, the Texas regions were subjected at irregular intervals to slight oscillations during which the alternate conditions of marsh and sea deposition took place and the presence of marine fossils in the lignitic beds appears to show that these marshes were also subjected to marine influences. The third reason for considering these beds as being synchronous with the Lisbon beds and partly with the green sands of the lower or lignitic beds is their contained fauna. Heilprin states that of some one hundred and forty-five species determined by him about sixty-one, or upwards of forty per cent. are also members of the Claiborne fauna of Alabama, and a few others also occur in some of the older deposits of Alabama. He considers these beds to belong to the Claibornian or typical Middle Eocene of the gulf slope.[56] After the examination of a much more extensive fauna obtained from these beds Mr. Harris arrives at the conclusion that they belong to the Lisbon sub-stage of the Lower Claiborne.[57] Gabb also arrives at the same conclusion in regard to the fossils found at Wheelock and in Caldwell county, as he says "they are all from a deposit apparently synchronous with that at Claiborne, Alabama; one-third of the species found in the Texan beds being specifically identical with those found in Alabama."[58]

The identity of the fossils found in the Yegua clays and Fayette sands with those of the Marine beds appears to place these two stages in the same age.

These beds occupy a wide area of country lying immediately north of the Yegua clays which form their southern boundary, and their northern line may approximately be drawn from the Sabine River a short distance north of Sabine Town in a generally northwestern direction to the middle of the eastern line of Smith County. Turning west the line continues in a west by south direction to near Brownsboro, in Henderson, and thence south to the Trinity near the south line of Anderson, and from there in a southwesterly direction to the Brazos. Throughout the northeastern portion of the state isolated hills covered by deposits of the same age occur in some of the counties. These, however, are usually unfossiliferous and of no great extent.[59] The main body of the beds occupies a position in the form of an inverted V, being widest at its apex, where a line drawn across them from Bullard through Jacksonville, Rusk and Alto measures over forty miles. From this line they gradually narrow both to the west and east until on the Brazos the width does not exceed thirteen miles, and on the Sabine not more than seven or eight.

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[56] Proceedings of the Academy of Nat. Sci., Phila., Oct., 1890, p. 393.
[57] Harris' Monograph of the Texas Tertiary Fossils MSS.
[58] Journal of the Acad. of Nat. Sci., Second Series, Vol. 4, p. 376.

The dip of these beds appears to be in an inverse ratio to the width—that is to say it is greater on the Brazos than farther east, and gradually becomes less as we approach the Sabine. While the great or general dip of the whole of these deposits is toward the gulf they have apparently been subjected to pressure from the south or southeast as in many places slight waving or undulations occur that give the beds the appearance of dipping toward the northwest in many places. These undulations are greater in the basal division or "Mount Selman series," and pass into the underlying lignitic. A very good type of this formation may be seen in Mount Selman itself as that mountain forms the bottom of a synclinal trough. They do not appear in the Yegua clays or succeeding deposits, and whether they affect the cretaceous beds or not is not known with any degree of certainty, although it is generally assumed that they do to some small extent.

The topography of the country occupied by the Marine beds may be described as an elevated plateau rising abruptly from the plane of the surrounding beds to an average elevation of five hundred feet above sea level, although some of the higher "mountains" reach elevations of over seven hundred feet. This plateau is so intersected by the different rivers flowing across it and their subsidiary drainage channels that it presents a much broken surface showing as narrow-topped, steep-sided, ridges in many places and wide flat-topped hills in others. This variation is chiefly due to the covering of the different localities. When sand forms the prevailing material the ridges are narrow and the reverse is the rule where we find the iron ore deposits overlying. Wide "bottoms" and "second bottoms" land fringe the margins of the main streams and many of the larger creeks, and the whole flow at very low levels, often one hundred to one hundred and fifty feet below the summit making deep V-shaped channels where no bottom lands exist. In many places, particularly in the sandy beds erosion is very rapid and many of the eastern water courses have reached and are now flowing in the underlying lignitic beds.

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[59] Science, Vol. XXIII, No. 571, pp. 22–25.

Throughout the higher grounds the surface is generally covered with light gray or yellow sand derived from the disintegration of the underlying beds through leaching or otherwise, and in places a light scattering deposit of yellow stained quartz gravel occurs. These upper beds support a heavy cover of short leaved pine, oak and hickory in portions of the region and wide areas in several of the counties towards the middle of the district are covered with heavy beds of laminated iron ore. These overlying sands and ores have been ascribed to the quaternary by Mr. L. C. Johnson,[60] but the occurrence of fossils of the same age as the underlying beds within them place them in the Marine beds and consequently of Eocene age.

LIGNITIC BEDS.

The northern boundary of the Marine beds marks the southern limit of an another series of deposits totally differing from these in every respect. In physical structure, materials and mode of deposition these lower beds have nothing in common with the overlying Marine beds. They form the lowest portion of Penrose's Timber Belt or Sabine river beds and are known as the Lignitic stage of the Texas Eocene. These beds comprise a series of sands, clays and lignites and have an aggregate thickness of over 1,200 feet.

The sands are variously colored, being white, yellow, brown, red, deposits, with the sands, and in such positions are usually laminated. Massive and stratified beds also occur in many portions of the area, sometimes nearly free from sand, but the greater portion occur as sandy or micaceous clays. Plastic potter's clay and refractory clays occur in abundance. In color they are generally dark blue, gray and black, although deposits of red, brown and yellow clay occur and frequently thin beds of white clay are found among the upper members of the series.

The lignites belonging to this stage and from which these beds derive their name occur widely spread throughout the whole area; they lie in beds of varying thicknesses, from two to four feet being most common, although six, nine and ten feet deposits are by no means of rare occurrence. Beds of even greater thickness have been reported as being found in well-borings. The actual number of lignite beds existing in these deposits is not known. Six have been recorded as underlying each other at distances varying from two to one hundred and twenty feet apart.

Silicious and calcareous sandstones and limestones occur at different portions of the area occupied by these beds, but the glauconitic greensand marls so conspicuous in the Alabama lignitic are everywhere absent from the Texas beds.

The lignitic beds have been divided into two divisions—an upper and lower—distinguished chiefly by their structure and composition. The upper or Queen City beds, so called from their typical development near that place in Cass county, comprise a series of laminated or thinly stratified white and red sands and sandy clays frequently merging into one another and forming a mottled sandy clay or clayey sand. The laminæ generally do not exceed one-fourth to half inch but the white sandy clay frequently expands to six or more feet filling pockets or depressions in the wavy laminated deposits. In this pocket-form these clays become less sandy and more aluminous than when occurring in thin seams. The section at Queen City shows these beds to have a thickness of 65 feet. This section is:[61]

1.	Gravelly ore, and broken pieces of nodular ore, sandstone and sand	5 feet.
2.	Laminated ore and sand in thin strata	4 "

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[61] Second Annual Report Geol. Survey of Texas 1890, p. 72.

3. Stratified white and red sand with white sandy clay (Queen City beds)	65 feet.
4. Brown sand and clay	25 "
5. Lignite	1½ "

These beds have never been outlined but are known to occur at various localities in Cass county. In Marion county, near Jefferson, and in Harrison county these beds appear at various places immediately underlying the yellowish brown sandstone here forming the base of the Marine beds. The same beds are also found at Willow Switch near Longview and Gladewater in Gregg Co.,, and also occur near Tyler in Smith county and at Wilkins' Mill in Upshur Co.

These beds are unfossiliferous throughout. Not the slightest trace of a fossil of any kind has ever been found in them and they do not carry lignite. They are, however, readily recognized, and whenever present, are conspicuous from their clear, distinct, banded appearance lying between the brown and brownish-yellow beds above and below them. They have been correlated with the Carrizo sandstones of the Tertiary west of the Brazos.[62]

The lower lignitic deposits are very different from the Queen City beds in many respects. These contain the dark blue, gray, black, brown and yellow clays and sands, sandstones and lignites so characteristic of the lignite group everywhere, and form by far the most extensive deposits belonging to this stage of the Eocene.

In Bowie county, in the extreme northeastern portion of the state, lignitic clays and lignites occur; in Cass county the same deposits show the typical structure at many places. A section at the Alamo mine, on Sulphur Fork, shows :

of 802 feet, but without reaching their base. Three heavy beds of lignite and a number of smaller ones are said to have been passed through in the boring. In Harrison and southward through Panola, Shelby and eastern San Augustine we find these deposits underlying the remnantal Marine beds and passing under the main body of these at many places. Everywhere throughout the Sabine Valley sections showing lignites may be seen. A section at Robertson's ford shows:

1.	Gray sand	1 foot.
2.	Mottled brown, blue and yellow clay	45 feet.
3.	Lignite	6 "
4.	Dark blue sandy clay to water	3 "

Near Carter's Ferry, on the same river, we find a deposit of lignite six feet thick containing trunks of trees from sixteen to twenty feet in length and eighteen to twenty inches in diameter, partly silicified and partly lignitized. These are exposed at low water. Near Logansport a section of the river bluff is reported to give:[61]

1.	Gray sandy soil	2 feet.
2.	Mottled yellow and gray clay	10 "
3.	Yellow and blue clay	4 "
4.	Nodular iron ore, nonconformable	1 foot.
5.	Sandy clay.	3 feet.
6.	Iron sandstone, irregular	1 foot.
7.	Lignitic shales to water	2 feet.

Coming westward, the same lignitic sands and clays with more or less lignite occur in Smith, Wood, Henderson, Freestone, Limestone, Leon and Robertson counties. Sections typical of the whole region can be obtained almost anywhere. The section of these beds as shown on the Brazos gives:

I. Calvert Bluff Section:—

Recent.	1.	Brown loamy clay	4 feet.
	2.	Light brown sand	7 "
	3.	Brown sand and gravel	1½ "
	4.	Gray sand	0 to 3 "
	5.	Brown coal	12 "
	6.	Dark blue clay	3 "
	7.	Brown coal	3 "

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[61] Second Annual Report Geol. Survey of Texas, 1890, p. 252.

Lignitic.	8.	Dark blue clay same as No. 6	6 feet.
	9.	Brown coal	3 to 4 "
	10.	Dark grayish blue sand	15 "
	11.	Thin stratum of calcareous sandstone	½ foot.
	12.	Dark gray sand similar to No. 10	2 feet.
	13.	Brown coal, poor quality	2 to 6 inches.
	14.	Dark gray sand similar to No. 10	8 feet.
	15.	Gray calcareous sandstone	1 foot.
	16.	Dark bluish gray sand with iron pyrites	8 feet.
	17.	Boulders of clay ironstone and gray calcareous sandstones with irony nodules and thin seams of ferruginous sandstones with dicotyledonous leaves	2 feet.
	18.	Gray sandstone	1½ "
	19.	Laminated bluish gray sand to water	2 "

A little over a mile farther up the river we find section II at Bee shoals showing the following beds belonging to the lignitic. Nos. 1, 2 and 3 of the section are omitted as they belong to the more recent and river alluvium:

II. Section at Bee Shoals:—

4.	Black or dark blue clay	5 feet.
5.	Broken seams of brown coal	½ to 3 "
6.	Black clay same as No. 4	5 "
7.	Dark bluish-gray sandstone weathering on outside to a brown containing broken plant remains	1½ to 6 feet.
8.	Clay similar to Nos. 4 and 6	4 "
9.	Thin stratum of gray calcareous sandstone	4 to 6 inches.
10.	Gray sand laminated and containing thin layers of dark clay	10 feet.
11.	Rounded waterworn boulders with calcite streaks	1 foot.
12.	Gray sand with pyrites	0 to 5 feet.

From this point to the base of the lignitic beds near the mouth of Pond Creek the beds comprise a series of gray sands interstratified with gray sandstones. These sands and sandstones cannot be less than 300 feet in thickness. A section at Gibson's gin near Calvert shows them to be at least 265 feet. The following is the section :

1.	Surface soil and gray and brown sand . . .	25 feet.
2.	Alternate strata of blue clay and calcareous sandstone	42 "
3.	Brown coal	2 "
4.	Bluish-gray sand, blue clay and calcareous sandstones	46 "
5.	Brown coal	1½ "
6.	Bluish gray sand	23½ "
7.	Brown coal	5 "
8.	Blue sands and sandstones	55 feet.
9.	Brown coal	2 "
10.	Red clay	8 "
11.	Bluish-gray calcareous sandstones and blue clay	22 "
12.	Brown coal	2 "
13.	Blue sand	76 "
14.	Brown coal	10 "
15.	Blue sand with thin seams of sandstone . .	265 "

A well at Franklin, the county seat of Robertson, obtains its water supply from these beds and is 1,208 feet deep. This boring is wholly in lignitic strata and chiefly in the lower division.

While there is no doubt whatever as to the stratigraphic position of the Texas Lignitic corresponding closely to that of the Lignitic of Alabama, both occupying positions beneath the Lower Claiborne and overlying the uppermost beds of the Cretaceous, there are many conditions of dissimilarity between them that mark the deposition of each to have been associated with and made under widely different circumstances. Nor do these Texas beds altogether correspond with the Lignitic of Mississippi, Arkansas or Louisiana, although in the case of the two last named States the beds found in the southwestern portion of Arkansas and in the northwestern corner of Louisiana are similar in every respect to those of that portion of Texas adjoining them.

In Alabama the greater portion of this sub-division is made up of laminated clays and laminated and cross-bedded sands of a prevailing gray color, except immediately below the Buhrstone, where for 200 feet or more they are of dark brown, often purplish colors. With the above mentioned laminated clays and sands are interstratified several beds of lignite and several beds holding marine fossils and usually characterized by the presence of glauconite or greensand.[64]

According to Smith and Johnson the lignites appear to be more numerous and thicker toward the west, while eastward of the Alabama River they become, as a rule, inconspicuous and possess no very well marked characters by which they may be distinguished from one another. On the other hand the Marine beds retain their characteristic features and peculiar association of fossils, are easily recognizable and may be followed with the greatest ease.

In Mississippi the Lignitic comprises a series of lignitiferous strata with interstratified beds of brown, yellow and gray sands and clays containing marine fossils and plant remains.[65]

These beds also occur in Southern Arkansas at the Ouachita Coal-mining Company's mines at Lester, about seven miles north of Camden. Here the section shows heavy beds of dark blue clay enclosing a deposit of lignite from 6 to 10 feet thick. The higher hills in this neighborhood are capped with the red and white sands and clays typical of the Queen City beds of Texas, and as already stated the southwestern portion of Miller county belongs geologically to the Texas beds.

Hill describes the basal or lignitic strata of southwestern Arkansas under the local names of the Camden series and Cleveland county red lands. The former, he says, "is an extensive shallow water, marine formation of stratified, micaceous, non-indurated alternating laminæ of sands and clay shales, sandy shales, thin sandstones

Hill. The basal Tertiary of the region while in its principal features undoubtedly lignitic and in places correspond to the Texas beds, his Camden series is only partially so, a portion belonging to the middle Tertiary or Claiborne and a still greater portion being of much younger age. At the base of this series Prof. Hill has also included as Tertiary some beds of cretaceous deposits. His Cleveland "red lands" are, according to Harris, of Claiborne and Jackson age.[68] It may also be stated that in some parts of Arkansas the Eocene is represented by a still lower phase than the Lignitic.

In Louisiana these beds are represented in the northwestern portion of the State. They have been described by Hilgard[69] and Hopkins[70] as the Mansfield group and recently by Dr. Otto Lerch as the Lignitic.[71] These beds are, in their main characteristics, similar to the lignitic of Texas and along the State line in Cass and Harrison Counties in Texas and Caddo Parish in Louisiana I have found them passing in unbroken continuity.

It would thus appear that the lignitic beds of East Texas can be directly connected with those of almost the whole of the Gulf States. A number of variations in structure undoubtedly occur between them and the corresponding beds of Alabama and Mississippi, where heavy beds of green sand, carrying numerous fossils form no inconsiderable portion of the series, and where the lignites are few and poorly developed. In Texas the lignites are very extensively represented by many beds of different thickness and make up a very fair proportion of the aggregate thickness of the lignitic stage and no trace of a single deposit of glauconite or green sand occurs anywhere. In fact, with the exception of petrified or silicified wood a few dicotyledonous leaves and stems of plants, all much broken, the entire series of the Texas Lignitic is wholly unfossiliferous.

If we follow Mr. Harris' division[72] and restrict the Alabama lignite to the first 600 feet of the beds considered by Smith and Johnson as belonging to that stage, we find constantly recurring changes from periods of low marshy coastal flats, during which the extensive beds of lignitic clays and shales and sands were laid down to periods in which the abundant fauna now buried in the glauconitic fossiliferous green sands found suitable conditions of life. Although these changes were such as to build up very heavy deposits of each class, it would appear as if none of them continued long enough to enable the contained plant life to accumulate a sufficiently large growth to form anything beyond the merest trace of lignite.

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[68] Geol. Survey of Ark., Vol. II of 1892, pp. 94-110.

[69] Am. J. of Sci., Vol. XLVIII, No. 144, Nov., 1869, p. 340.

[70] First Annual Report Geol. Survey of La., 1870, p. 83.

[71] Geol. and Agr. of North Louisiana. La. Exp. Sta. Bull., 1892, p. 9.

[72] Am. J. Sci., Vol. XLVII, April, 1894, p. 304.

During the whole of this period only some seven or eight seams of lignite have been laid down, and even these, with the exception of one, do not exceed two feet. In the first 200 feet, including the whole of the Hatchetigbee section and uppermost 30 feet of the Woods Bluff, no lignite occurs. Below this we have some 25 feet with thin beds. Of the 140 feet forming the Bells Landing stage only five feet of lignite are found, and these occur in three seams, the upper one of which is 2 feet thick and lies some 75 or 80 feet above the other two, which are only from 6 to 8 feet apart. The next lower or Nanafalia section shows 200 feet of gray sandy clays and cross bedded sand and glauconitic sands and clays with green sands containing *Gryphæa thirsæ*. About ten feet above the base, a bed of lignite from 4 to 7 feet thick occurs and this is the only lignite seen in that series.

Throughout the Texas areas the lignite beds everywhere form conspicuous objects in this horizon, although no attempts have yet been made to correlate them with each other.

These beds apparently represent a period when the whole coast was made up of swamps, lagoons and bayous, the extent of which when compared with the enormous amount of such wood found in the overlying sands.[73]

With the exception of a narrow strip of country lying to the west of a line drawn southward from the cretaceous border near Cooper, in Delta County, and passing a few miles to the west of Sulphur Springs, to the east of Emory, four miles east of Wells Point, between Mexia and Tehuacana and crossing the Brazos about a mile north of the Milam Falls County line, the lignitic deposits occupy the whole territory lying between the northern boundary of the Marine beds and the southern line of the Cretaceous. Along the eastern border of the State this area has a width of almost 160 miles but rapidly narrows in coming west. A line drawn across these beds through Tyler, Mineola and Sulphur Springs, to the cretaceous border on the Sabine, near the south side of Delta County, is only 75 miles and their exposure on the Brazos does not exceed 16 miles.

Along the western side, these beds rest upon the basal beds of the Texas Eocene, to the north they overlie and come in direct contact with the cretaceous marls and on the east, as already stated, they pass into Arkansas and Louisiana. To the south they are overlaid by the Marine beds and altogether cover an area equal to at least one-third of the whole Eocene tertiary in the State.

The dip of these beds appears to be gently towards the southeast, but the undulations referred to in the Marine beds also occur in the lignitic, making many instances of apparent return or northwesterly dips, and thereby making an effort to arrive at the actual thickness of the beds through the measurement of the dip difficult and of only doubtful accuracy. Fortunately, however, many deep borings have been made at various points and from these we are enabled to obtain a fairly accurate measurement of the thickness.

The topography of the country is simple. In the east the higher elevations are those points capped by the lower beds of the overlying Marine and which give the country a somewhat broken appearace. Near the centre and westward the country becomes of a more uniform level. It is mostly covered with heavy growths of pine and oak with mesquite bushes along the Brazos and through Robertson

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[73] For connection between these beds and the Cretaceous see Science, Vol. XXII, No. 565, Dec. 1st, 1893, p. 300.

County. Prairie conditions prevail over some areas but only to an inconsiderable extent.

BASAL BEDS OR WILLS POINT CLAYS.

These beds form the lowest deposits of Eocene age in Texas and rest directly upon the marls of the Cretaceous. They correspond in time with the Mathews Landing, Black Bluff and Midway sections of the Alabama lignitic and Harris' Midway stage of the lower Eocene.

In Texas these beds are represented by a series of yellowish brown, brown and bluish gray sands, yellow and blue laminated clays and massive clays containing numerous boulders of silicious limestone and two beds of white fossiliferous limestone. The yellowish brown sand contains numerous boulders of calcareous sandstones and limestone veined and streaked with calcite and enclosing occasional fossils and the sands themselves also carry a few broken shells. White, limy concretions and crystals of selenite are also numerous in some of the clays.

These beds have an aggregate thickness of about 260 feet and they occupy a narrow strip of country lying between the Lignitic on the east and the Cretaceous areas on the west. Their greatest width does not exceed some 13 miles in the vicinity of Wills Point and gradually narrowing to a point at each end. The greatest length from north to south does not exceed 170 miles.

The detailed information regarding these beds is meagre from the

2.	Thinly laminated dark blue clays with broken bivalve shells in the upper division and occasional nodules of limestone	30 "
3.	Yellow Ponderosa marls forming the highest Cretaceous bed at this place	—

The contact between these beds and the underlying Cretaceous as seen in the Brazos river section presents a section of:

1.	River alluvium	4 feet.
2.	Gravel	1 foot.
3.	Blue clay and sand breaking into nodules and conchoidal pieces, weathering into a grayish yellow and containing *Cucullæa macrodonta* Whitf., *Yoldia eborea* Conrad, *Venericardia alticosta* Con., var., *Calyptrophorus velatus* Con., *Cerithium* sp., *Crassatella* sp., *Apporhais gracilis* Ald., and *Ostrea pulaskensis* Harris[14]	5 feet.
4.	Transitional blue clay	1 foot.
5.	Massive blue clay with Baculites and other Cretaceous fossils	14 feet.

About 90 feet above the base as seen at Elmo in Kaufman county there are two beds of limestone, the upper one measuring eight feet and the lower ten feet in thickness. These are separated by two feet of brown sand. These limestones are highly fossiliferous containing such fossils as *Cucullæa macrodonta* Whitf., *Venericardia alticosta* Con., var., *Venericardia planicosta* Lam., *Crassatella* (Midway sp.,) *Cytherea* sp., *Pyrula* (*Fusoficula*) var. *Pseudoliva unicarinata* Ald., *Pleurotoma* (*Pleurotomella*) *anacona* Harris, n. sp., *Ostrea pulaskensis* Harris and *Turritella* sp.

These two beds are seen about a mile north of Elmo in the following section:

1.	White fossiliferous limestone	8 feet.
2.	Brown sand	2 "
3.	Limestone same as No. 1	10 "
4.	Dark bluish gray sand	30 "

At Rocky Cedar only the upper bed is seen and is here 20 feet thick.

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[14] Harris MSS.

Whether these limestones form a connected bed throughout the whole length of the area is not known. They occur about twelve miles further south at Kemp where they contain *Cucullæa macrodonta* Whitf., *Cytherea* sp., *Turritella alabamensis* var. *prealaba* Con., and *Mesalia alabamensis* Whitf.[75]

In the vicinity of Tehuacana, Limestone county, these limestone beds again make their appearance with an increased thickness. Here the beds form the surface over considerable areas and are underlaid by a brownish gray sand presenting the following section:

1.	Whitish to grayish white limestone containing *Ostrea alabamensis* Lea., *Volutilithes* sp., *Venericardia planicosta* Lam., *Cytherea* sp., *Mesalia alabamensis* var. *medvia* n. v. Harris, *Turritella multilira* Whitf., and *T. alabamensis* var.	40 feet.
2.	Brownish gray sand changing to a brown near base	—
3.	Black shaly clay (Cretaceous)	—

These limestones are again seen at Hornhill in the same county where they carry practically the same fauna and the Brazos section is seen in the following:

(a.) Section at Oyster Bluff (Penrose), Two Miles Above Mouth of Pond Creek:—

1.	River alluvium	4 feet.

tra Har., *Cytherea, Natica. Cerithium whitfieldi* Heilprin, *Pseudoliva ostrarupis* Harris, n. sp. *P. ostrarupis* Harris, n. var., *Fusus ostrarupis*, Harris, n. sp., *Pleurotoma* (*Pleurotomella*) *anacona* Harris n. sp., *Pl.* (*Surcula*) *ostrarupis* Harris n. sp., *Cerithium penrosei* Harris, n. sp., *Tellina* (*Leda*) *milamensis* Harris large variety, n. sp., and *Leda milamensis* Harris.[76] These fossils occur almost altogether in the beds of blue clay.

The section shown at this place is probably the uppermost beds belonging to the Basal clays and No. 4 may represent a transition bed between these and the overlying lignitic, as it partakes of some of the character of both stages. The nearest known lignitic beds in the river section are at the mouth of Pond Creek, two miles below, but occur away from the river on both sides much nearer than this, although no actual contact can be seen :

(b.) Section on C. Cribbs League, Between Two and Three Miles Above (a.):—

1. Brown sand and gravel	2 feet.
2. Yellow clay	4 "
3. Ledge of silicious limestone, fossiliferous . .	2 "
4. Yellow clay same as No. 2	5 "
5. Limestone same as No. 3	2 "
6. Dark blue laminated clay showing lines of lamination on weathering.	30 to 35 "

The fossils obtained from this locality embrace *Cucullæa macrodonta* Whitf., *Yoldia eborea* Conrad, *Volutilithes rugata* Conrad, *Venericardia alticosta* var. Conrad, *Calyptrophorus velatus* Conrad, *Nucula magnifica* Conrad, *Crassatella kennedyi* Harris, n. sp., *Fusus ostrarupis* Harris, n. sp., *Dentalium* sp., *Turritella mortoni* Conrad, var., *Ostrea pulaskensis* Harris, and *Lucina*.[77] These fossils mostly occur in the limestone ledges which here, although much altered in texture and appearance, evidently represent the two beds found at Elmo and on Rocky Cedar. The limestones here and at the next section above are soft and easily broken, of a brownish gray appearance on the outside but are grayish blue in the interior. They have a tendency to break up and assume a nodular form.

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[76] Harris MSS.

[77] Harris MSS.

Half a mile below the contact of the Cretaceous and at the foot of Blue Shoals we have another section :

(c.) Section at foot of Blue Shoals Half a Mile Below Tertiary—Cretaceous Contact on Brazos River :—

1.	Brown sand river alluvium	10 feet.
2.	Blue indurated clay with boulders of limestone containing *Ostrea pulaskensis* Harris, and other fossils	5 "
3.	Laminated blue almost black fossiliferous clay with thin seam of indurated clay on top . .	4 "+

The fossils obtained here with the addition of *Turritella alabamensis* Whitf., *Pecten alabamensis* Aldr., and a species of *Cerithium* are the same as those occurring in (b.) a few miles down the river and most of them occur at the Tertiary–Cretaceous contact half a mile farther up. These have already been shown.

These beds as shown in the river section undulate to such a degree that many of them dip sharply and pass beneath the river level only to rise again in some small exposures farther down. These undulations are not uniform in their length as the usual condition appears to be a long gentle slope, succeeded by a sharply abrupt descent which is represented in a much slower rise where the same beds appear again. On this account we have two different rates of dip towards the southeast with one towards the northwest, although the since been eroded and carried off, or whether they are covered up by the overlapping of the later beds we have as yet no evidence to offer, but if they occupy the same relative position here as in the west, then the presumption is that they never existed and that they occupy a very minor position in the Tertiary scale and were only laid down in isolated positions, and, while differing materially from the great body of the lignitic, should be considered as the equivalent in time at least, to a portion of the basal deposits of that stage. No lignites occur in them and they appear to be at least partly of marine origin.

Mr. Harris has classed the Matthews Landing marls, Black Bluff clays and Midway clay and Limestone of the Alabama Lignitic under the single title of "Midway." In this the Texas Survey has followed Mr. Harris and whether the Texas beds will admit of the threefold division made in Alabama, or, if so, where the lines of separation are to be drawn our present information will not allow a definite settlement of the question. As it appears at present these beds can be correlated only with the last two, Black Bluff and Midway. The clays and limestones with their contained fossils as found on the Brazos and in the neighborhood of Elmo and Wills Point correspond closely to these divisions but whether the gray sands and sandy clays with their boulders of calcareous sandstones can be correlated with the Mathews Landing, the proof is at present deficient.

These beds, unlike the lignitic, cannot be traced continuously across the intervening States. They are not continuous in Texas and only appear as isolated deposits of generally small extent in Arkansas, and Smith seems to think the "Flatwood" in Mississippi belong to the same age.

The country occupied by the Basal beds in Texas is generally undulating, and prairie-like conditions prevail throughout the northern portion. Towards the south the prairies are broken by growths of dwarf mesquite which is fast covering the whole area.

RÉSUMÉ OF HISTORY.

The close of the Cretaceous in the East Texas region found the physiographic conditions of the coast line much the same as we find them along the present shore. The coastal plain comprised a series of clays in places, giving place to sands in others. Nowhere were any of the harder limestones of the upper cretaceous seen. This cretaceous shore line undoubtedly stood at a slightly higher elevation and extended many miles to the southward of where we now find its outcroppings. The "islands" or isolated patches of beds belonging to that age, found in the salines of Smith, Vanzandt and Anderson Counties then formed an integral portion of the uppermost cretaceous beds. In front of this line and extending from 75 to 100 miles still farther south and seaward, there was a subcoastal plain or submerged plateau lying at no great depth below the waters of the gulf and probably more or less subject to exposure at low tide.

With the exception of the Brazos and Trinity Rivers no large streams broke the coast line but numerous smaller water courses, corresponding to such streams as the Angelina, Nelus, San Jacinto and others, in times of freshets, poured their torrents of muddy debris-laden waters into the shallow sea, covered the subcoastal plain with a varied assortment of sand, mud, leaves, branches and trunks of trees and quantities of other vegetation and probably animal remains, and in periods of dry weather dwindled down to shallow pools and sluggish bayous in which their waters scarcely moved.

Although the land stood higher than at present this was essentially a period of subsidence and denudation. So far as we can see, the currents must have set in from the southwest and the waters along the western side of the tertiary areas were deeper and stronger than those along the northern coast. A deep channel from 15 to 20 miles wide appears to have been excavated along the eastern cretaceous shore, cutting off the cretaceous islands now found, and in place of

The sea then had free access to this portion of the shore, at least, and the clear marine water meeting the mud-laden fresh water of creeks and rivers caused the latter to drop their burdens with the result of a deposition of a great depth of laminated clays and sands.[79] Marine and fresh, or brackish water conditions alternately prevailed. The subsidence continued and the marine conditions becoming stronger many of the marine forms of life gradually crept up along the shore and we have a solid eight feet of limestone. A slight change takes place and two feet of sand are laid down, again to be succeeded by another bed of limestone of the same character as before, this time ten feet in thickness.

Following this upper limestone we have 120 feet of clay and finally 30 feet of sand with calcareous boulders and a few fossils and then another change takes place. The old channel with its sands, clays and limestones is completely obliterated and a shallow, brackish water condition of affairs takes place, covering the whole area from west to east with a totally different set of deposits. These form the great lignitic series of this region.

The changes that ushered in the lignitic stage brought about the final destruction of the glauconitic sandy portion of the upper cretaceous, completed the isolation of the cretaceous islands and laid down great beds of sand along the whole coast. Owing to extensive overlapping of the newer members of the series, the base of these beds is seldom seen but wherever sufficiently deep exposures occur the basal portion of these lignitic deposits are found to be made up of coarse bluish-gray, to gray, sand with occasional interstratified strata of indurated sand or soft sandstone, more or less calcareous, and at wide intervals these deposits are interstratified with thin strata of laminated clay. In the Brazos River section these deposits have a thickness of about 300 feet, but they become thinner as they extend eastward and westward from this line. In the northeastern portion of the State these sands rest directly upon the cretaceous and are very much thinner and have a thickness of probably not more than 50 feet.

The conditions brought about by these changes appear to have been inimical to animal life, or at least to the preservation of its remains. Nowhere within the whole region has a solitary individual fossil been found and even the lignite so plentiful in the upper clayey portion of the lignitic appears to be wanting altogether or is extremely scarce. From this condition we might infer that the coast line was for a long time faced by a broad expanse of littoral sands, over which the sea flowed intermittently and at irregular periods, and at different depths, carrying with its waves enormous, although irregular quantities of sand. The fresh water streams, with the exception of the two rivers, the Brazos and Trinity, having no fixed channels spread their deposits over the sands to be afterwards re-arranged by the succeeding tidal waters.

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[79] Geikie's Text Book of Geology, Second edition, p. 355.

The marine action being intermittent the sandy shores would necessarily be exposed to atmospheric agencies for frequent and probably considerable periods of time, while the fresh water deposits would be thin and widely spread, and disturbed if not altogether destroyed, by every inundation of the sea. Under these conditions the irregular thickness of the beds and their indurated portions may readily be accounted for while at the same time they would be extremely inhospitable for molluscan life and any stray shell that might find its way into the region would suffer desiccation and be almost immediately broken to a fine powder. Many of the bays along the southern coast of Scotland present the same features at the present day. There we have a series of deposits of sands and clays forming the immediate shore line elevated from 7 to 10 feet above a broad foreshore of sand, over which the sea only flows at periods of extreme high water or during storms. Immediately in front of this, the greater portion of its water and at the same time damming back the rivers allowed the fresh water to gradually spread over the whole area and form a fresh water lagoon into which the rivers and streams in time of floods carried great quantities of mud and fine sand. The deposition of these in the still waters of the lagoons gradually formed the sandy clays found sparingly distributed among the sandy deposits. But as the whole work of the sea is an incessant building up and tearing down, a period of storms or extra high water would eventually destroy the sandy barriers and again the whole flat would be subject to marine influences and the deposition of marine deposits. Probably the rivers themselves, by the washing out of the bars at their mouths aided in the work.

Although the land had gradually subsided, the subsidence scarcely kept pace with the upbuilding of the sea and each succeeding inroad would have less influence than the preceding, until a time would be reached when the rivers and streams gained the ascendancy and then would commence a time of heavier and more extensive clayey deposits. Most of these clayey deposits are laminated and from this we may infer that they were never absolutely beyond marine influence, however weak it may have been at times.

At that time, we may reasonably suppose, the sea had formed a broad bar of sufficient strength to prevent the ingress of salt water except on very exceptional occasions or at low points in much the same manner as along the present coast. No doubt there were some differences but these we are unable to point out as all evidences have long since been covered up by overlying deposits or erosion.

It was to this time we may ascribe the beginning of the deposition of the vast beds of lignite so prominent throughout the greater portion of the area. Prior to this no lignite appears to have been formed and none have been found in the lower sands. It must be remembered that throughout the whole lignite field the lignites rest upon clays and that these clays contain great quantities of carbonaceous matter in the forms of leaves and stems of delicate plants, none of which could bear transportation to any great distance.

Many conditions of origin have been ascribed to these lignitic deposits. Some writers assert "that these beds were formed as off-shore deposits and the beds of lignite are accumulations of land vegetation carried out to sea and becoming water-logged, sunk in heaps in much the same manner as beds are forming in the bed of the present gulf."[80] Others, again, ascribe to the lignites a swamp or lagoon formation and favor the theory that the greater portion of the necessary vegetation grew where the lignite is now found. Dr. Penrose attributes their origin in Texas to bayous and lagoons on the coast and says: "Such places were probably heavily timbered and year after year the trees dropped their leaves and dead branches on the moist ground. Here they collected and were mixed with dead reeds, moss, grass, etc. As the trees themselves died, they also lay down in the same grave and rotted in the same boggy waters as their leaves and branches, until often a great thickness of decayed vegetable matter had been collected."[81] Another theory might be added. These lignite beds grew upon the exact spots in which they are now found and are due to the swampy condition of the region, but the material contributing to their structure did not consist of large trees but rather of the growth of small marsh plants such as are found in the underlying clays, that the presence of tree trunks in these beds is largely adventitious and brought in during periods of inundation. When the plant growth became strong enough to support arboreal vegetation small trees undoubtedly did grow in some portions of the lagoon but never to such an extent that they could contribute much toward the formation of the great lignite deposits as we now find them.

To the first of these theories, that the beds of lignite are due to accumulations of land vegetation carried out to sea, there are many and serious objections. In the first place, we have the wide, almost ness of sands and clays were laid down. Another point not satisfactorily explained by this theory is the general homogeneity of structure exhibited by these beds and their freedom from interlaminations of or interstitial clays. Vegetable deposits due to drift material would naturally contain more or less clay intermixed with the deposit. And again we can hardly suppose the sea to have been devoid of either vegetable or animal life.

The theory that these lignite beds were formed from materials growing *in situ* while probably it does not explain all the difficulties attached to the question comes much nearer doing so than any other. As far back as 1828 A. Brongniart held the opinion that coal was formed of plants growing *in situ* and in 1853 Le Conte taught that coal was formed as in the peat swamps of the present day, but these swamps occurred at the mouths of large rivers and were subject to overflows by the rivers and occasional inundations by the sea.[82] The absence of river mud he ascribes to a straining operation of the plants along the margins of the swamp and quotes Mr. Lyell as the authority for the statement that "although the peat swamps of the Mississippi are annually flooded by river water they are entirely untouched by river mud. These favored spots are surrounded, partially on the side next the river, by dense vegetation, which, acting as a sieve, completely strains the water of its mud before it reaches the peat swamp. The water of these swamps is, therefore, pure, and pure peat has been quietly depositing there for ages.

According to Gümbel coal should be considered an inland deposit formed in wide, flat depressions of continents and also on low grounds along the sea coast. Undisturbed growth of marsh vegetation alternated with floods during a long continued subsidence might reach locally a thickness of several thousand yards of successive beds of coal, sandstone and shale.[83]

As already suggested the sea had reached to a considerable distance south of the lignitic areas and a broad but low sand bar, broken in places, protected the sandy plains from marine invasion. Erosion had begun work on this sandy waste and the different streams were being gathered into the courses they were subsequently to occupy. This cause of destruction operated rapidly, as it does now, and in a comparatively short period the chief drainage outlets such as the Sabine, Sulphur, Neches and the other smaller rivers had outlined their main channels and drainage areas. The Brazos and Trinity rivers being already formed, enlarged their scope of operations, and here, we have also to consider the influences of the Red River and Mississippi drainage systems on the coast. Fresh water gradually spread over the greater portion of the regions and by the deposition of the loads of mud brought down by the different streams covered the flat, sandy country with a soft clayey soil. Irregularities of deposition, accentuated by the irregularities of erosion and the eternally changing conditions of the sand bars in the rivers and the periodical flooding and low water changes in the rivers led to the formation of irregular ridges of sand and the lenticular deposits of clay we now find throughout the whole area.

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[82] Smithsonian Institution Report of 1853, pp. 136–137.

[83] Beiträge zur Kenntniss der Texturverhält d. Mineralkohlen, 1883.

The damming of broad valleys of erosion by the sand bars at their mouths formed wide tracts of marshy lands or lagoons and these gradually acquiring a vegetation fitted for such localities became the birth places of our extensive lignite beds.

This condition went on year after year, periodical floods brought into the marshes additional supplies of fresh water. There is no reason to suppose there was a greater absence of the straining influences of the plants along the outer edges then, than now, and every one can see this operation being carried on in marshy regions at the present day. The presence of small trees occasionally found in the lignite beds may be accounted for by the fact that during the course of time these marshes acquired a suface soil of sufficient density to support a growth of such swamp loving trees as cypress, gum, etc.

This vast growth of vegetation implies several conditions of existence. The climate must have been moderately warm, very moist and the whole surface of the land slowly subsiding. The whole territory lay at a very small elevation above the sea and but a slight oscillation of the land was necessary to place the whole again within the grasp of the sea.

How many times these conditions were repeated we do not know. That would depend upon the number of lignite beds, but as these have not been correlated with each other, if indeed they ever can be, over any more than small areas, even these cannot be taken absolutely as a chronometer reliable enough to indicate the number of oscillations that may have taken place.

Towards the close of this stage there came a time, however, in which the sea began to assert its right of domain and to again cover the face of the country with sand and sandy clay.. This time is represented in the beautifully striped or banded beds of the Queen City deposits. The time of lignite making had come to an end and a new order of things commenced. These beds represent a period of comparative quiescence, and from the uniform thickness of the lamination and alternate banding of red and white sands and clays, appear to have been a beach formation. How far these beds covered the lignites is not known; they are only found as remnants of what probably was a very widely extended series of deposits. Their northern boundary shows signs of extensive erosion and their southern margin has never been seen.

The relative time of deposition of these beds could not have been very long as the greatest thickness found anywhere does not exceed 65 feet. They probably represent a period in which the land lay very low and open to a long sweep of tidal waters.

A slight change in the relative positions of land and sea again brought deeper water along the Texan coast and heavy beds of sand were heaped up and spread along the shore. A few of the marine forms of life began to appear. Among them we find some such as *Venericardia planicosta*, *Turritella* sp., and which had survived the changes from the basal beds up. This condition continued until nearly 300 feet of sands and sandy clays had been deposited. The faunal life increased somewhat during that time but did not, so far as our evidence shows, reach the quantity of richness of the latter half of this period.

About this time a change due to some extraneous causes occurred. Whatever the cause of this change may have been it induced a flexing, or gentle undulation, involving the whole series from the middle of the Marine beds backward to and including a portion of the upper Cretaceous. This flexing apparently brought the long period of subsidence to an end. The whole of the lower Marine beds were brought to the surface and a period of elevation began. During this stage the last 250 feet of the Marine beds were deposited in comparatively shallow water and along a sandy floor sloping gently seaward.

With the close of the Marine beds the elevation ceased, and for a long period the land remained stationary. During that time erosion was working actively. The sea to the southward was cutting the sloping shores and carving them in many places into steep cliffs; the rivers were widening and deepening their channels, carrying their burdens of debris seaward and depositing them in the shallow waters of the Gulf. Here these materials were sorted and arranged into banks of sand with muddy intervals, gradually filling up the shallow shore waters. Again we find the marine waters being gradually closed out, the streams gathered into sluggish bayous and the whole drainage system disarranged. Fresh and salt waters met and mingled in the bayous and occasional inundations covered the whole region. Marsh plants, grasses, reeds and palmettos gradually overspread the wide domain now occupied by the Yegua clays. Again we have a period of slow subsidence and a return to deposits would be somewhat unconformable to the lower and submerged ones and would have an appreciable quantity of shore debris mixed with the cleaner marine sands.

This is the condition in which we find the lower deposits of the Fayette sands. These beds are irregular in form, wedge-shaped, cross-bedded and often lenticular, the whole indicating a deposition in very shallow water subject to a strong sweep of the tide and often affected by storms. The life of the time as represented in these beds shows leaves, stems and trunks of trees belonging to low-lying, marshy lands. Palm wood is plentiful while the stems and leaves of the palmetto, rushes and marsh grass may be found in some localities in abundance, showing that when these beds were being deposited the marshy tracts of the Yegua clays to the northward were still the home of such growths. None of these are indigenous to the Fayette sands and exist there only in the form of drift material cast up by the sea. Near the top of the Fayette sands we find trunks and limbs of trees of large size, many of them even now showing diametric measurements of over three feet, and although some show a length of 25 or 30 feet the greater portion of the logs do not exceed ten or twelve feet in length. Occasionally a stump with the larger roots attached may be found, but this exceedingly rare. A peculiarity regarding these trees is that they are every one in the form of wood opal or in an opalized condition, vitreous and clear when broken, breaking with sharp cutting edges and retaining every mark and line of growth as it appeared in the tree. The outside of these woods is generally a dull white showing a process of decay. This form of wood is peculiar to the Fayette sands and occurs nowhere else within the Texan regions.

The faunal life connects these beds with the whole series of the Eocene stages as shown in the Texan section and is decidedly marine in every phase. *Venericardia planicosta* Lam., *Calyptrophorus velatus* Con., *Mactra* sp., *Dentalium minutistriatum* Gabb, var. *dumblei* Harris and *Corbula alabamensis* Lea, as well as many others represent the inhabitants of this portion of the sea at that time.

To the southward the land was sinking and the sea creeping farther up over the Fayette shores. A deposit of clay was being laid down which within a short time was destined to become the last representative of Eocene times in this portion of the world. These were the Frio clays. With the deposition of these clays the Eocene of Texas came to an end.

Towards the close of the Fayette time there began a series of earth movements the initial causes, or full effects of which, cannot be indicated or understood by what we may observe within the East Texas areas. Only a few of the results, and these are small, may be seen there. Hot springs with an abundance of silica in solution appear to have formed a predominant feature and silicious sinters form extensive deposits through several counties occupied by beds of Fayette time. To these solutions of silica we may possibly ascribe the transformation of the fossil wood into the condition it is now found as well as the many deposits of quartzite found in the same portions of the State.

These earth movements and the deposition of the sinter continued through the deposition of the Frio clays with which many of the deposits are interstratified and while we need not discuss the causes of these movements here it may be said that the ultimate effect was, at least in Texas, to elevate the whole of the Eocene beds into dry land and this condition continued far into Miocene times.

THE ARRANGEMENT OF THE RETINAL CELLS IN THE EYES OF FISHES PARTIALLY SIMULATING COMPOUND EYES.

BY JOHN A. RYDER.

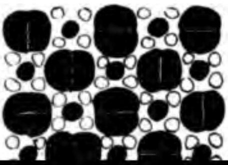
The peculiar structure of the compound eyes of the Arthropods has attracted a large share of attention from such investigators as Grenacher, Lankester, Watasé, Patten, Carrière and others. The peculiarities of structure of compound eyes are so marked that it would be strange if they failed to attract the notice of students of morphology. In the vertebrates the structure of the retina is universally regarded as differing so widely from that of the compound type of eye found in the Arthropods, that few authors have been tempted to institute any very close morphological comparison between them. I should not attempt such a comparison were it not that I have recently found that in the eye of the larval salmon, *Salmo salar*, there is an arrangement of the sensory cells of the retinal epithelium that is so regularly and definitely repeated throughout the whole extent of the retina as to admit of no question.

The observations upon which my statements rest were made upon certain very thin sections of recently hatched salmon larvæ. These sections were prepared for an entirely different purpose, and it was only upon casual observation that the peculiarities I am about to describe were first noticed.

These sections ranged from 2.5 to 5 mikrons in thickness, and no doubt can be thrown upon my observations on the score of faulty technique. The specimens had been splendidly fixed and preserved and were stained *in toto* in an alcoholic solution of hæmatoxylin, and differentiated *in toto* in a one per cent. solution of potassium bichromate. This method leaves but little to be desired for clearness of histological differentiation and sharpness of detail. Unfortunately, it is only a very few sections out of a complete series that reveal the details that are to be described. These few sections are the first three or four that were cut tangentially to the surface of the retina, and that which is cut just through the ends of the rods and cones and cone-cells, at about the level of the inner or under side of the layer of retinal pigment. One, therefore, only obtains six to eight sections in sectioning an entire eye; that is, three or four just as the surface of the retina is reached by the knife, and again just as it leaves off cutting through the retina at the opposite side of the eyeball. In other words, very superficial tangential sections only, or such as are cut in a plane very nearly coincident with the bacillary or Jacob's layer will show the regular repetition of structure that impels me to make a comparison between the compound eyes of Arthropods and the retinal structure of the larval salmon.

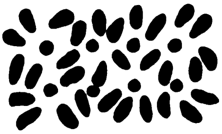
The first thing that strikes the observer in examining such sections is the extraordinary regularity with which the bacillary portions of the retinal elements are arranged. One notices that the rods and cones form together a pattern of the most astonishing regularity. That the rods are in groups of four or five, but that the cones are much larger across and always in pairs, or of the nature of Hannover's double cones and united together closely at their apices. These double cones are arranged in rows in two ways at right angles to each other, like the squares on a chess-board, Fig. 1. If

FIG. 1.



densely stained, and while still showing a paired condition are no longer in contact, and no longer have their adjacent faces flattened as when united, as in the preceding section. One may now count eight cone cells arranged in four groups, of two each, around a single very distinct rod, Fig. 2. This arrangement is at first somewhat difficult to make out, but it requires only a short time for the observer to convince himself that a regular arrangement of the rods and cones also obtains at this lower level. This evidence conclusively establishes the fact that every one to five rod-cells in the eye of a larval salmon are surrounded by eight cone-cells that are closely opposed or united at their apices into four pairs of two each. At a slightly deeper level the bodies of the pairs of cones separate still more, but traces of a regular pattern can still be made out at a third level.

FIG. 2.



I have stated in the title of this paper that there is an arrangement of retinal cells of fishes that partially simulates that of the retinal elements in the compound eyes of Arthropods. This definite proviso is necessary because the comparison between the groups consisting of four or five rod-cells and four double cones in the retina of the salmon cannot be exactly homologized with the cell-groups known as ommatidia in the Arthropod eye. In the latter each ommatidium is distinct from its adjacent fellows and none of its cellular elements enter into the formation of the contiguous ommatidia by which it is encircled. In the retina of the larval salmon the case is very different and quite peculiar. Of any one group consisting of five central rod-cells and four double cone-cells, the latter also enter into the formation and form part of eight adjacent similar groups of cells. Into four of the eight adjacent groups two double cone-cells enter, and, alternating with these are four other groups into which only a single pair of the double cone-cells of the central group enters. The comparison is therefore only a partial one. It is obviously absurd to suggest the complete homology of a group consisting of the five central rod-cells and their four surrounding double cones in the retina of the salmon with a single ommatidium of the Arthropod eye.

To what extent a similar condition holds in the arrangement of the bacillary retinal elements in other groups of vertebrates I am not prepared to say. But this remarkable regularity and repetition of arrangement of cellular elements in the retina of a fish is at least very suggestive. Blaue has shown that the olfactory organ of fishes is made up in some cases of very small discrete sense-organs simulating the structure of taste-buds and the small circular sensory buds found in the lateral line organs of fishes. Ayers has traced the probable origin of the complex sensory structures found in the cochlea of vertebrates to a multiplication and subsequent coalescence of originally discrete sense-buds or end-organs, that arose in a way similar to the discrete end-organs of the lateral line. The detection of regularly repeated groups of sense-cells in the retina of one of the lower vertebrates thus becomes highly significant. Is it possible, after all, that the retina of vertebrates has been evolved by the coalescence of very small groups of sense-cells that were at one time separate and simple sense-organs, just as the complex olfactory and auditory sensory epithelia of vertebrates appear to have so arisen? The arrangement that has been described appears to extend throughout the whole of the functional part of the retina of the larval salmon, so that the grouping of the cells is at least uniform in this type during the early stage of its existence. This is a feature that alternate, in vertical sections of the retina also, and with the utmost regularity with the single central rod elements. Such alternating rods and double cones are met with only in sections cut through the greatest diameter of the eye and exactly vertical to the maximum thickness of the retina, as should be expected from the manner of arrangement of the rods and cones, as seen in sections that are cut horizontally through the bacillary layer and parallel to a plane tangent to its convex surface.

Max Schultze has figured portions of the bacillary layer of the retina of mammals, as seen from the surface, and one sees in such figures that the cones are repeated at regular intervals, the more numerous rods surrounding the cones. In the retina of the salmon this arrangement is reversed, or at least is not so obvious unless one assumes that every double cone in this form is supposed to be encircled by eight rods. In the salmon the cone elements are most numerous; in mammals they are less numerous than the rods over a very large portion of the retinal surface. These facts together with the rest of what has preceded do not conflict, however, with the view that the groups of cells met with in the retina of the young salmon are fairly to be regarded as having arisen from a condition in which such groups of rods and cones were more or less distinct and separate as in the compound eyes of Arthropods. On morphological grounds alone, it seems to me, that we are driven to some such conclusion. No matter what convictions one may hold as to the utter untenability of any hypothesis that seeks to derive the vertebrates from the Arthropods or *vice versa*, it seems probable from the evidence now at hand, that highly complex and specialized sense-organs of all kinds, including, possibly, the retina of vertebrates, have arisen by the coalescence of simpler, smaller and more numerous sensory organs. That the sense-organs of both vertebrates and Arthropods have pursued parallel paths in the course of their evolution seems highly probable. The frequency with which specialization, reduction and even apparent simplification, in some respects, of organs, in the course of organic evolution, is associated with a process of coalescence of more numerous structures having the same function, is very strongly in favor of such a conclusion.

The single groups of retinal elements in the retina of *Salmo*, comprising, as we have seen above, thirteen cells, I propose to call *retinaidia* in contradistinction to what is met with in the Arthropod eye, where the single visual organs are known as ommatidia. This distinction is a necessary one in view of the fact that it is obviously impossible to assert, in the face of the morphological evidence, that there is an exact homology between what are known as ommatidia and the cell-groups in *Salmo* that I have called retinidia. I have found it difficult to determine the exact number of rod-cells in the center of the groups. As nearly as can be made out with an immersion $\frac{1}{12}$ there are five. At first when this regularity of structure of the salmon's retina was noticed with low powers it was supposed that there was only one rod-cell in the centre of each retinidial group. The overlapping or blending of these groups with one another in *Salmo* is shown in both Figs. 1 and 2, and this is the one feature that makes it impossible to homologize them exactly with the ommatidia of the compound eyes of Arthropods.

THE TRUE NATURE OF THE SO-CALLED "NETTLE-THREADS" OF PARAMŒCIUM.

BY JOHN A. RYDER.

It is well known that if *Paramœcium aurelia* is hurt or irritated in any way that it will discharge from its cuticle what appear to be filaments. This has been known for more than a century, for Elliot in the Philos. Transactions of the Royal Society for 1769, pl. VI, p. 150, gives a very good figure of a *P. aurelia* with these threads projecting from its surface produced by the juice of the horse-shoe geranium. Dr. G. J. Allman in Vol. III of the Quar. Journ. of Microscop. Science (1855), nearly a century later, upon reinvestigating this subject, comes to the conclusion that these discharged threads are of the nature of nettling or defensive organs and that they are discharged from minute oval or elongate cysts that are closely imbedded in the ectosarc just beneath the cuticle of these organisms. Allman also concludes that they are not identical with the cilia which thickly clothe the organism. Various reagents are known to cause this discharge of thread-like processes from the cuticle or surface of *Paramœcium*, but no reagent that I know of does this so effectually as tannic acid, the peculiar potency of which, for this purpose, was first pointed out by H. Warrington (Journ. Roy. Microscop. Soc., 1884).

Most naturalists who have written in recent years upon the structure of the Protozoa have accepted Allman's statement that the threads discharged by *Paramœcium* are not ciliary in nature. Lankester, among others, makes such a statement very positively. Fortunately there are two ways in which to test the truth of this statement.

1. It so happens that if a pretty strong solution of tannic acid is used these threads are entirely detached from the body of *Paramœcium*, if the reagent is allowed to act long enough. Endosmotic action is also thus set up so that the cuticle is lifted off of the underlying ectosarc, which, together with the endosarc, now shrivels into a disorganized, granular mass. The cuticle is seen to be thin and to

be very faintly striated in optic section the striæ extending through it, and closely approximated to one another. The cuticle is smooth and entirely without cilia in this condition, so that a tannic acid solution enables one to completely remove the cilia and also to separate the cuticle from the underlying plasma. The tannic acid acts, in short, as a sort of "depilatory," removing, apparently, every vestage of cilia from the creature. The "threads" thus removed are very long and of nearly the same thickness throughout. They are not much shorter than the short diameter of the body of the creature, but do not taper as do the cilia.

This singular behavior of tannic acid in removing all trace of the presence of cilia from the body of *Paramœcium* has led me to doubt the non-ciliary nature of the threads thrown off by the body of this infusorian. If these threads are not cilia why should there be no trace of cilia left on the cuticle after the prolonged action of a solution of tannic acid? These threads form a dense mat of tangled fibres in the midst of which lie the shriveled remains of its sarcode covered by the cuticle that is now lifted up and everywhere freed from contact with the ectosarc if the creature is subjected to prolonged treatment with tannic acid solution. On *Euplotes*, *Stylonchia* and *Halteria* tannic acid has no such action, proving that these organisms in some way differ very widely in their reaction toward that reagent as compared with the slipper-animalcule. This singular power of tannic acid gives rise to grave suspicions as to the truth of the statement that the "threads" developed by tannic acid on the surface of *Paramœcium* are something different from the cilia. In order to test this suspicion it was necessary to resort to sections of the infusorian in question to see if there really was any ground for the very positive statement of E. R. Lankester and T. J. Parker as to the existence of a fundamental difference between these so-called "nettle-threads" and the cilia of *Paramœcium*.

2. By the aid of a method of entrapping, killing and embedding infusoria and other very small objects in paraffine invented by me and fully described in the American Naturalist, XXIX, 1895, pp. 194–198, it has been possible to obtain serial sections of *Paramœcium*, in quantity, of a thickness not exceeding 2.5 mikrons, $\frac{1}{10000}$ inch. These sections so fully reveal the true structure of the ectosarc that nothing further is needed to show how completely this agrees with the view that the "nettle-threads" are nothing but

greatly stretched cilia, that are probably extended by some physical action exerted upon them by the tannic acid that has both stretched and swollen them.

The ectosarc of *Paramœcium* is composed entirely of a system of vertical rods of a plasmic substance that stains somewhat more deeply than the endosarc. These rods are cylindrical and densely packed together with but little clear plasma between them. They extend throughout the whole thickness of the ectosarc and compose more than four-fifths of its substance. They are so closely packed together that their arrangement can very readily be made out to correspond to the origins of the cilia from the cuticle. The arrangement of the cilia is quincuncial, that is, in rows in at least two if not in three directions, which correspond with the mode of arrangement or packing together of the rods of denser plasma of the ectosarc just beneath the cuticle.

The sections show that where the cuticle is intact and where reagents like osmic acid or corrosive sublimate have provoked the discharge of the "nettle-threads" there are no cilia; where, on the other hand, there has been no discharge of "nettle-thread" there are cilia present. Intermediate stages can also be sometimes discovered, that is, partially discharged "nettle-threads" may be observed. These facts seem to me to most distinctly prove that the "nettle-threads" and cilia of *Paramœcium* are identical. No one has yet seen these threads discharged except under abnormal conditions. Though I have watched these organisms feeding by the hour I have yet to see that they showed the slightest tendency to throw off the "nettle-threads" except when crushed, roughly handled or brought under the influence of reagents. The fact that few other infusorians have such a distinctly rodded ectosarc, taken together with the fact that other forms are not affected in the same way by tannic acid leads me to conclude in consideration also of the great number of these rods in the ectosarc of *Paramœcium* that they are connected with the cilia individually and are probably only the expression of the same thing as is seen in the rodded or striated ends of many epithelial cells that bear cilia in multicellular animals. At any rate, whatever else can be established by a reinvestigation of this subject by the aid of the methods I have used, one thing is certain, that tannic acid in solutions of almost any strength will finally remove all of the cilia and leave the cuticle smooth especially if allowed to act for half an hour or more. My sections also conclusively prove the ectosarc to be quite thick and composed of uniform, deeply staining rods that are packed as densely in one place as another. The form of these rods as figured by several authors is wholly inaccurate and misleading. For example, they are not fusiform or oval as figured by Lankester in his article Protozoa in the ninth edition of the Encyclopedia Britannica, but cylindrical with bluntly rounded ends. Where the collapsing vesicles ("contractile vesicles" of authors) are placed there appears to be a peculiar separation of these rods at their inner ends to admit of the approximation of the vesicles to the under surface of the cuticle.

For killing and fixing my material I found that osmic acid and corrosive sublimate gave good results, both these reagents acting with such rapidity as to exclude in a large measure the production of artifacts. Staining was done on the slide with hæmatoxylin and Biondi-Heidenhain mixture. Nuclei and food vacuoles are apt to stain strongly if the staining on the slide is attempted with hæmatoxylin. Very good results can also be got by staining the objects *in toto*, as directed in the paper cited above describing my method of handling such very minute objects.

MARCH 5.

DR. SAMUEL G. DIXON in the Chair.

Twenty-five persons present.

Papers under the following titles were presented for publication: "On an Arrangement of the Retinal Cells in the Eyes of Fishes Partially Simulating Compound Eyes," by John A. Ryder. "The True Nature of the so-called 'Nettle Threads' of Paramœcium," by John A. Ryder.

The death of John H. Redfield, a member, on the 27th ult., in his eightieth year, was announced. The following minute was unanimously adopted:

JOHN H. REDFIELD.

The Academy of Natural Sciences of Philadelphia has heard with deep sorrow the announcement of the death of John H. Redfield who, in his unselfish devotion to its interests, has long been one of its most active benefactors.

Always an earnest student of nature, his last years of deserved freedom from business engagements were devoted to his favorite studies in connection with the Academy and to the arrangement and care of the herbarium.

The steady growth and admirable condition of the botanical collection constitute it an enduring monument to his industry and zeal.

As Chairman of the Publication Committee and member of the Council, the same fidelity and discretion characterized the discharge of his duties.

He was a man of strong but tender character; firm in his support of the right, but tolerant of all honest difference of opinion; cheerful, gentle, modest and cultured. Time was to him one of his most precious possessions, yet he was ever gladly at the service of those requiring advice or assistance.

He was an earnest student, a wise counsellor and a steadfast friend. His encouragement and loving sympathy endeared him to his associates who felt for him a personal affection which enables them to appreciate the irreparable loss sustained by his family, to whom they would offer their heartfelt sympathy.

Mr. Thomas Meehan was appointed to prepare a biographical notice of Mr. Redfield.

MARCH 12.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Thirty-three persons present.

The death of Geo. N. Lawrence, a correspondent, was announced.

Papers under the following titles were presented for publication: "A Study of the Systematic and Geographic Distribution of the Decapod Family Crangonidæ Bate," by Arnold E. Ortmann. "Does the Delaware Water Gap Consist of Two River Gorges?" by Emma Walter.

Dr. Harrison Allen was elected to fill the vacancy in the Council caused by the death of Mr. Redfield.

MARCH 19.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Twenty-six persons present.

The deaths of Passmore Williamson and Dr. Elmore C. Hine, members, were announced.

A STUDY OF THE SYSTEMATIC AND GEOGRAPHIC DISTRIBUTION OF THE DECAPOD FAMILY CRANGONIDÆ BATE.

BY ARNOLD E. ORTMANN.

In a former paper[1] I gave in general terms the limits of the Indo-Pacific litoral region, to which I added a study of the origin of the recent litoral regions of the world. As these considerations, founded upon the geographical distribution of the Decapoda, contain but a few detailed investigations, it is necessary to go more into detail when a separate group of Decapoda is examined and to state the relations to the principles given in the paper quoted. In 1891 I revised the genera *Palæmon* and *Bithynis*[2] and gave an account of their geographical distribution. In 1894 I published an account of the family Atyidæ.[3] These groups of fresh water crustacea are wholly unlike each other in respect to their geographical range and agree only in that they are true tropical animals. Whilst the *Palæmon* and *Bithynis* group of the Palæmonidæ is a very recent one, related in its distribution, without doubt, to the limits of the recent marine litoral regions, the family Atyidæ is comparatively an ancient one, showing in no way relations to the former.

In the present paper I will treat of a true marine group, the family of Crangonidæ, which is characterized by the adaptation of most of its members to the cold waters of the Arctic and deep sea regions.

Fossil remains of Crangonidæ are unknown. In all species referred with more or less doubt to this family, the typical characters are not evident. The absence of Crangonidæ from the Tertiary deposits agrees with their morphological characters and their supposed recent development. They form the most extreme end of one of the two main branches of the Eucyphidea.[4] The principal character is the more or less reduced condition of the second pair of pereiopoda. The

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[1] Jenaische Denkschrift. VIII, 1894. p. 68 P. Crustaceen in Semon, Zoolog. Forschungsreisen in Australien und dem malayischen Archipel.

[2] Zoologische Jahrbücher, V, 1891, p. 693–750.

[3] Proceed. Acad. Nat. Sci. Philadelphia, 1894, p. 397–416.

[4] Ortmann, Zoolog. Jahrb., V, 1890, pp. 462, 463.

Crangonidæ are connected with the Nikidæ by the genus *Glyphocrangon*, but this connection is not a close one—there are some gaps.

Among the Crangonidæ, the genus *Pontocaris* is no doubt the most primitive in regard to the sculpture of the carapace; the number of gills and the shape of the second pair of pereiopoda. From *Pontocaris* arise two divergent branches: the one through the subgenus *Sclerocrangon* to *Crangon*, ending in *Nectocrangon*, characterized by no shortening of the second pair of pereiopoda, by the reduction of the number of gills, and by the surface of the body becoming gradually smoother. The other branch is represented by the genera *Pontophilus*, *Sabinea*, *Paracrangon*, characterized by the reduction of the second pair of pereiopoda in length, by retaining the primitive number of gills and the sculpture of the body. In *Pontophilus* some species have the body more or less smooth. The genus *Prionocrangon* is an aberrant one, without eyes, but related probably to the genera *Pontophilus* and *Sabinea* of the second branch.

CRANGONIDÆ Bate, 1888.

Crangoninæ Kingsley, Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 411.
Crangonidæ Bate, Challenger Macrur., 1888, p. 481, Ortmann, Zoolog. Jahrb., V, 1890, p. 462.

Mandibles simple, slender, incurved, not dilate or bifid, without a synaphipod. First pair of legs stouter than the second, hand sub-

c_2. Second legs remarkably shortened (carpal joint and hand together not longer than the merus). Gills seven.[5]
  d^1. Second legs chelate . . . . PONTOPHILUS.
  d_2. Second legs not chelate . . . . SABINEA.
b_2. Eyes wanting. Second legs not chelate, rather robust, with fringes of long, plumose setæ A spiny median crest on the carapace . . . . PRIONOCRANGON.
a_2. Several pairs of legs wholly obsolete. Rostrum elongated. . . . . PARACRANGON.

PONTOCARIS Bate, 1888.

Bate. Challenger Macrur. 1888, p. 495.

Very nearly allied to *Crangon*, especially to *Sclerocrangon*. Second periopoda not remarkably shortened, carpus and palma together longer than the merus. Six pleurobranchiæ (i–o) and one podobranchia (h) present (see Bate, l. c., p. 496). Carapace with seven keels, the five uppermost dentate. Abdomen sculptured.

a_1. Anterior lateral angles of carapace projecting forward. Rostrum acuminate . . . . *P. propensalata.*
a_2. Anterior lateral angles of carapace obliquely directed outward and forward. Rostrum bidentate . . . . *P. pennata.*

1. **Pontocaris propensalata** Bate, 1888.

Bate, Challenger Macrur. 1888. p. 496, pl. 90, figs. 2, 3, pl. 85, fig. 5.

Geographical distribution: Ki Island, near New Guinea, 140 fath. (Bate).

2. **Pontocaris pennata** Bate, 1888.

Bate, ibid., p. 499, pl. 91.

Geographical distribution: Arafura Sea, 49 fath. (Bate).

CRANGON Fabricius 1798 (restrict).

Fabricius, Suppl. Entomol. Syst., 1798, p. 409 (pr. part). Kingsley, Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 412.

Second pereiopoda not remarkably shortened, with chelæ. Eyes present, free. Five gills present: four pleurobranchiæ (l. m. n. o.), one arthrobranchia (k.).[6]

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[5] The number of gills has not been examined in all species. I found five gills in: *Crangon boreas, salebrosus, intermedius, typicus, affinis, franciscorum, Nectocrangon lar*, and seven in *Pontophilus norvegicus, Sabinea septemcarinata*. By other authors (Bate, Smith) are recorded five in *Crangon agassizi*, and seven in *Pontocaris propensalata, pennata, Pontophilus brevirostris, abyssi, challengeri, Sabinea hystrix*.

[6] Smith records in *Cr. agassizi* a pleurobranchia on k, but no arthrobranchia. The branchial formula given by Bate (l. c., p. 482) is certainly wrong.

G. O. Sars creates for some species the genus *Sclerocrangon.* I can not adopt this genus, but I retain it as a subgenus.

a^1. Carapace strongly sculptured, at least two spines in the median line. Abdomen mostly strongly sculptured, seldom nearly smooth. . . . . Subgenus: SCLEROCRANGON.

- b_1. Median keel of carapace with three or four spines. Lateral keels of carapace partly granulate or rugose. Abdomen sculptured by longitudinal keels and transverse furrows.
  - c_1. Epimera of the abdominal segments provided with spines. Carapace with more than three keels. Spines not excessively developed. Sternum with a sharply serrated keel.
    - d_1. Keels of the carapace sharply granulated, keels of the abdomen sharp, epimera of the abdominal segments with one to three spines.
      - e_1. The rostrum is simple . . . . *Cr. salebrosus* (1)[7].
      - e_2. A long acute tooth is given off from the lower side of rostrum, which reaches as far forward as the tip of the rostrum . . . . *Cr. atrox.*
    - d_2. Keels of the carapace somewhat rugose, keels of the abdomen not sharp. epimera of the abdominal segments only with one spine each . . . . *Cr. boreas* (14).
  - c_2. Epimera of the abdominal segments without spines. Carapace with three keels, the median one with four very long spines. Sternum with a dentated keel . . . . . *Cr. sharpi* (2).
- b_2. Median keel of carapace with two spines. Lateral keels of carapace smooth, ending in front in the usual spines. Abdomen smooth, or with smooth longitudinal keels.
  - c_1. Epimera of the first and second abdominal segments with small spinules. Abdomen with longitudinal keels. Often a

b_1. Carapace with three spines: one in the median line, and two laterals.

c_1. Fifth segment of the abdomen on the posterior margin without spines. Hand more stout, about three times as long as broad . . . . *Cr. crangon.*

SUBSPECIES.

d_1. All segments of the abdomen rounded dorsally.
. . . . *Cr. crangon* (many).

d_2. Some of the posterior segments of the abdomen sculptured.

e_1. Fourth and fifth segments (seldom also the third) with a feeble longitudinal keel, sixth and seventh feebly furrowed.
. . . . *Cr. crangon affinis* (many).

e_2. Third to fifth segment without keels, sixth with two distinct keels, seventh furrowed . . *Cr. crangon allmanni* (1).

c_2. Fifth segment of the abdomen on the posterior margin, near the median line, with a posteriorly projecting spine on each side.

d_1. Hand more slender, about four times as long as broad. Abdominal segments rounded above . *Cr. franciscorum* (many).

d_2. Hand more stout, about three times as long as broad. Sixth and seventh segment of abdomen furrowed.
. . . . *Cr. antarcticus.*

b_2. Carapace only with a spine in the median line, the lateral ones wanting . . . . *Cr. capensis.*

Subgenus SCLEROCRANGON G. O. Sarr, 1885.

G. O. Sars, Den Norsk. Nordhavs Exped., Zool., Crust. I, 1885, p. 14.

1. **Crangon (Sclerocrangon) salebrosus** Owen, 1839.

Crangon salebrosus Owen, Crust. Zool. Beechey's Voy. Blossom, 1839. p. 88, pl. 27, fig. 1. Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 25. Kingsley, Bull. Essex Instit., 14, 1882, p. 129. Stuxberg, Vega. Exped. V, 1887, p. 53.

Cheraphilus ferox G. O. Sars, Arch. Mathem. Naturvid. II, 1877, p. 339.

Sclerocrangon salebrosus (Ow.) G. O. Sars, Den Norsk. Nordh. Exped., Zool., Crust. I, 1885, p. 15, pl. 2.

Geographical distribution: Northern circumpolar.—Kamschatka (Owen): Avatska Bay, 10 fath. (Stimpson), Spitzbergen, Jan. Mayen; off Norway, 100–459 fath. (G. O. Sars), Kara Sea, 55–60 fath. (Stuxberg).

2. **Crangon (Sclerocrangon) atox** Faxon, 1893.

Faxon, Bull. Mus. Comp. Zool. 24, 1893, p. 199.

Geographical distribution: Western coast of Mexico, 660–676 fath. (Faxon).

3. Crangon (Sclerocrangon) boreas (Phipps) 1774.

Cancer boreas Phipps, Voy. North Pole, 1774, p. 190, pl. 12 fig. 1.
Cancer homaroides Fabricius, Faun. Grönland, 1780, p. 241.
Astacus boreas (*Ph.*) Fabricius, Entomol. Syst, II, 1793. p. 483.
Crangon boreas (*Ph.*) Fabricius, Suppl. Ent. Syst. 1798, p. 409. Sabine, Suppl. Append. Parry's first Voy. 1824, 235. Milne-Edwards, Hist. Nat. Crust. II, 1837, p. 342. Kroyer, Naturh. Tidsskr., IV, 1842, p. 218, pl. 4, figs. 1–14. Milne-Edwards, Atlas. Cuvier, Regn. Anim. pl. 51, fig. 2, (no date). Brandt, Krebse, in Middendorff's Siber. Reis., II, Zool. 1851, p. 114. Danielssen, Beretn. Zool. Reise, 1859, p. 4. Stimpson, Proceed. Acad. Nat. Sci. Philadelphia, 1860, p. 25. Buchholz, Zweite Deutsch. Nordpol. II, 1874, Crust. p. 271. Kingsley, Bull. Essex Inst. X, 1878, page 54. Smith Trans. Conn. Acad., V, 1879, p. 56. Stuxberg, Vega Exped., V, 1887, p. 53.
Cheraphilus boreas (*Ph.*) Miers, Annal. Magaz. Nat. His. (4) XX, 1877, p. 57. Hoek, Niederl, Arch. Zool, Suppl. 1, 7, Crust. 1882, p. 10. Murdoch, Rep. Pol. Exped. Point Barrow, 1885, p. 139.
Crangon (*Cheraphilus*) *boreas* (*Ph.*) Miers, Jour. Linn. Soc., Zool. XV, 1881, p. 60.
Sclerocrangon boreas (*Ph.*) G. O. Sars, Christiania Vid. Selsk. Forh. 1882, p, 7. G. O. Sars, Den Norsk. Nordh. Exp. Zool. Crust. II, 1886, p. 6. Koelbel, Die Oesterr. Polarst, Jan Mayen, III, 1886, Zool. E. p. 51. Ortmann, Zool. Jahrb. V, 1890, p. 532.

Geographical distribution: Northern circumpolar. Norway (Danielssen, G. O. Sars) Barents Sea and Nowaja Semlja, 25–140 fath. (Hoek); Franz Joseph Land (Miers); Beeren Island (G. O. Sars); Spitzbergen, shallow water (Hoek, G. O. Sars) Jan Mayen (Kölbel); Iceland (Kröyer); east coast of Greenland, 4–27 fath. (Buchholz); west coast of Greenland, to 87° 44' lat. northward (Miers); Davis Strait and Melville Island (Sabine); N. E. coast of America, from Labrador to Massachusetts Bay, 5–33 fath. (Smith); northern coast of America to Berings Strait, 10–26 fath. (Stimpson); Alaska: Point Franklin, 13 fath. and Port Clarence (Murdoch); Siberia (Brandt, Stuxberg).

Geographical distribution: Alaska, Kodiac Archip.: Marmot Isle, 45 fath. (Sharp).

5. **Crangon (Sclerocrangon) agassizi** (Smith), 1882.

Cheraphilus agassizi Smith, Bull. Mus. Compar. Zool., Cambridge, X, 1882, p. 32, pl. 7, fig. 4, 5. Rep. U. S. Fish Comm. for 1882, 1884, p. 362.

Geographical distribution: Atlantic, eastern coast of United States, 31—41° N. Lat., 65–78° W. Long., 263–959 fath. (Smith).

6. **Crangon (Sclerocrangon) procax** Faxon, 1893.

Faxon, Bull. Mus. Comp. Zool., Cambridge, XXIV, 1893, p. 199.

Geographical distribution: Western coast of Central America: Gulf of California to Panama Bay, 660 to 905 fath. (Faxon.)

7. **Crangon (Sclerocrangon) intermedius** Stimpson, 1860.

Crangon intermedius Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25.
Crangon tenuifrons Kingsley, Bull. Essex Inst., 14, 1882, p. 128, pl. 1, fig. 10.

Geographical distribution: Bering Sea, Cape Chepoonski, 40 fath. (Stimpson); Alaska: Marmot Isl. (Kingsley).

8. **Crangon (Sclerocrangon) angusticauda** de Haan, 1849.

Crangon angusticauda de Haan, Faun. Japon. Crust. Dec., 6, 1849, p. 183, pl. 45, fig. 15. Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25.
Sclerocrangon angusticauda (d. H.) Ortmann, Zoolog. Jahrb., V, 1890, p. 533.

Geographical distribution: Japan, (de Haan): Simoda and Hakodati, sublitoral (Stimpson), Kadsiyama (Ortmann).

9. **Crangon (Sclerocrangon) munitus** Dana, 1852.

Crangon munitus Dana, U. S. Explor. Exped. Crust., 1852, p. 536, pl. 33, fig. 5. Stimpson, Boston Jour. Nat. Hist., VI, 1857, p. 497. Kingsley, Bull. Essex Inst. X, 1878, p. 54. Lockington, ibid. p. 159.

Geographical distribution: Puget Sound (Dana); Lower California: Magdalena Bay (Lockington).

Subgenus CRANGON.

10. **Crangon crangon** (Linnaeus), 1758.

Cancer crangon Linnaeus, Syst. Nat., 10 ed., 1758, p. 632.
Astacus crangon (L.) Fabricius, Entomol. Syst., II, 1793, p. 486.
Cancer (Astacus) crangon L. Herbst, Krabb. u. Krebse, II, 1796, p. 75, pl. 29, fig. 3,4.
Crangon vulgaris Fabricius, Suppl. Ent. Syst. 1798, p. 410. Leach, Malac. Podophth. Brit. 1815, pl. 37 B. Milne-Edwards, Hist. Nat. Crust. II, 1837, p. 341 and Atlas in Cuvier, Regn. Anim. pl. 51, fig. 1, (no date). Kroyer, Naturh. Tidsskr., IV, 1842, p. 239, pl. 4, fig. 29–33. Bell, Brit. Crust. 1853, p. 256. Kinahan, Proceed. R. I. Acad. Dublin, 1862, p. 68, 71, pl. 4. Heller, Crust. südl. Europ. 1863, p. 226, pl. 7, fig. 89. Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 198. Kingsley, Bull. Essex Inst., X, 1878, p. 53. Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1878, p. 89, ibid. 1879, p. 411. Smith, Trans. Connecticut Acad. V, 1879, p. 55. Kingsley, Bull. Essex

Inst. XIV, 1882, p. 129, pl. 1, fig. 5. Carus, Prodrom. faun. mediterr. I. 1884, p. 482. Henderson, Decap. and Schizop. Crust. Firth of Clyde, 1886, p. 32. Bate, Challenger Macrur. 1888, p. 484. Ortmann, Zool. Jahrb. V, 1890, p. 530.

Crangon rubropunctatus Risso, Hist. Nat. Crust. Nice, 1816, p. 83. Risso, Hist. Nat. Europ. merid. V, 1826, p. 65.

Crangon septemspinosus Say, Jour. Acad. Nat. Sci., Philadelphia, I, 2, 1818, p. 246. Dekay, Zool. New York, Crust. 1844, p. 25, pl. 8, fig. 24.

Crangon maculosus Rathke, Mem. Acad. St. Petersburg, Sav. étr., III. 1837, p. 366.

Geographical distribution: Northern circumpolar (?), but more boreal than arctic, extending considerably southward. Northern Atlantic: European coasts, northward to Iceland, and northeastern coast of America, southward to Virginia and N. Carolina. Northern Pacific: Japan, Yokosuka (Bate) and Bay of Tokio (Ortmann). Litoral, very shallow water.

10b. Crangon crangon affinis de Haan, 1849.

Crangon vulgaris Owen, Crust. Zool. Beechey's Voy. Blossom, 1839, p. 87. Dana, U. S. Explor. Exped. Crust. 1852, p. 536. Murdoch, Rep. Pol. Exped. Point Barrow, 1885, p. 138.

Crangon affinis de Haan, Faun. Japon. Crust. Dec. 6, 1849, p. 183. Bate, Challenger Macrur. 1888, p. 484, pl. 86, fig. 1–3. Ortmann, Zoolog. Jahrb. V, 1890, p. 531.

Crangon nigricauda Stimpson, Proceed. Calif. Acad. Sci., I, 2, 1856, p. 89. Stimpson, Boston Jour. Nat. Hist. VI, 1857, p. 496, pl. 22, fig. 6., Stimpson Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25. Kingsley, Bull. Essex Inst. X, 1878, p. 54. Lockington, ibid. p. 159.

Crangon propinquus Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25.

Crangon nigromaculata Lockington, Proceed. Calif. Acad. Sci., III, 1876, p. 34.

Crangon alaskensis Lockington, ibid.

Geographical distribution: Northern Pacific, somewhat deeper water. Japan (de Haan): Kobe Bay and Inland Sea, 15–50 fath.

water. England and Ireland (Kinahan); Scotland, 24–69 fath. (Metzger); Shetland Isl. (Kinahan); North Sea, 9–20 fath. (Metzger, Scott); Skagerrak and Kattegat, 6–49 fath. (Metzger, Meinert); Norway (G. O. Sars); Iceland, 20–30 fath. (G. O. Sars).

11. **Crangon franciscorum** Stimpson, 1856.

Stimpson, Proceed. Calif. Acad. Sci., I, 2, 1856, 89. Stimpson, Boston Journ. Nat. Hist. VI, 1857, p. 495, pl. 22, fig. 5. Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 25. Kingsley, Bull. Essex Inst. X, 1878, p. 54.

Geographical distribution: W. coast of N. America, shallow water. Puget Sound, Shoalwater Bay, Tomales Bay, San Francisco, Monterey (Stimpson).

12. **Crangon antarcticus** Pfeffer, 1887.

Pfeffer, Naturh. Mus. Jahrb., Hamburg. wiss. Anstalt. IV. 1887, p. 45, pl. 1, fig. 1–21.

Geographical distribution: South Georgia, (Pfeffer).

13. **Crangon capensis** Stimpson, 1860.

Stimpson, Proceed. Acad. Nat. Sci., Philadelphia, 1860, p. 24.

Geographical distribution: Cape of Good Hope, Simons Bay, 12 fath. (Stimpson).

NECTOCRANGON Brandt, 1837.

Argis Kroyer, Naturh. Tidsskr. IV, 1842, p. 267 (nomen præoccupatum).
Nectocrangon Brandt, Krebse in: Middendorff's Siber. Reis. II, Zool. I, 1851, p. 114. Kingsley, Proceed. Acad. Nat. Sci., Philadelphia, 1879, p. 412.

Second pereiopoda not shortened, with chela. Five branchiæ, like *Crangon*. Eyes partly concealed by the frontal margin. Posterior pereiopoda with lanceolate dactyli with fringes of hair.

a_1. Behind the rostrum two spines in the median line of carapace. . . . . *N. lar* (4).

a_2. Behind the rostrum three well developed spines in the median line of carapace, between the rostrum and the first spine a rudimentary one . . . . *N. alaskensis* (1).

1. **Nectocrangon lar** (Owen) 1839.

Crangon lar Owen, Zool. Beechey's Voy. Blossom, 1839, p. 88, pl. 28, fig. 1.
Argis lar (Ow.) Kröyer, Naturh. Tidsskr. IV, 1842, p. 255, pl. 5. fig. 45–62.
Nectocrangon lar (Ow.) Stimpson, Proceed. Acad. Nat. Sci. Philadelphia, 1860, p. 25. Stimpson, Annal. Lyc. New York, X, 1874, p. 125. Kingsley, Bull. Essex Inst. X, 1878, p. 55. Smith, Trans. Connect. Acad. V, 1879, p. 61. Murdoch, Rep. Pol. Exped. Point Barrow, 1885, p. 139.

Geographical distribution: Northern circumpolar.—Arctic Ocean

(Owen, Stimpson); Northern Alaska: Point Barrow (Murdoch); Bering Strait: Avatska Bay, 10–20 fath. (Stimpson); Greenland: Godthaab (Kröyer); Labrador, (Smith); Gulf of St. Lawrence (Smith); New Foundland: St. Johns (Stimpson); Nova Scotia, 59 fath.; Halifax, 26–52 fath. (Smith).

2. **Neotocrangon alaskensis** Kingsley, 1882.

Kingsley, Bull. Essex Inst. XIV, 1882, p. 128.

Geographical distribution: Alaska, Kodiac Arch.: Marmot Island (Kingsley).

PONTOPHILUS Leach, 1815.

Pontophilus Leach, Melacostr. Podophth. Brit. 1815, pl. 37 A.
Egeon Risso (pr. part.) Hist. Nat. Europe mérid., V. 1826, p. 58.
Cheraphilus and *Aegeon* Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 68, 69.

Second periopoda shortened, carpal joint and hand together not longer than merus, chelæ present. Eyes present, free. Gills seven on each side: six pleurobranchiæ (i. k. l. m. n. o.) and one (rudimentary) podobranchia (h.).

a_1. Median keel of carapace with more than three spines. Seven keels on the carapace, with numerous teeth. Abdomen strongly sculptured.
  b_1. Rostrum emarginate . . . . *P. cataphractus* (4).
  b_2. Rostrum acute, with lateral teeth . . . . *P. bengalensis*, *P. andamanensis.*[9]
a_2. Median keel of carapace with three spines. Abdomen smooth or

b_2. Carapace with two lateral spines and a third very small one behind the supraorbital fissure. Rostrum with two minute lateral teeth on each side. Abdomen smooth. Eyes colorless . *P. abyssi.*
P. occidentalis.

b_3. Carapace with two indistinct lateral keels, each with a spine. Sixth and seventh segments of abdomen feebly furrowed. Rostrum acute, with a lateral tooth on each side . *P. challengeri* (2).

b_4. Carapace with one lateral spine and a series of small spinules. Fifth segment of abdomen sculptured, sixth and seventh furrowed. Rostrum obtuse . . . . *P. pattersoni.*

a_3. Median keel of carapace with two spines.

b_1. Abdomen strongly longitudinally and transversely sculptured. Carapace with a two-spined median keel, and two many-spined lateral ones on each side. Rostrum emarginate . . . *P. sculptus.*

b_2. Abdomen smooth or only with a few longitudinal keels.

c_1. Carapace with distinct and denticulate lateral keels.

d_1. Three lateral keels, the upper with two, the lower with one, the middle without teeth. Rostrum truncate . *P. bidentatus.*

d_2. Two lateral keels, the upper with five, the lower with three teeth . . . . *P. australis.*

c_2. Carapace with two lateral spines. Rostrum acute, slender. Abdomen without keels.

d_1. Rostrum without lateral teeth . . . . *P. junceus.*

d_2. Rostrum with one lateral tooth on each side. Spines of the lateral faces of carapace in an oblique plane . . . *P. gracilis.*

d_3. Rostrum with two lateral teeth on each side. Spines of the lateral faces of carapace in the same level . . . *P. profundus.*

c_3. Carapace without lateral spines and without distinct keels. Rostrum short, obtuse, fifth and sixth segments of abdomen with two longitudinal keels . . . . *P. bispinosus* (1).

a_4. Median keel of carapace with one spine. Abdomen smooth.

b_1. Carapace with three lateral spines and a longitudinal series of small spinules . . . . *P. intermedius.*

b_2. Carapace with one spine on each side . . . . *P. trispinosus* (1).

b_3. Carapace without lateral spines.

c_1. Rostrum broadly truncate. Telson furrowed . *P. fasciatus* (5).

c_2. Rostrum short, obtuse. Telson rounded dorsally.
. . . . *P. neglectus.*

a_5. Median line of carapace without spines. Carapace with seven keels, keels smooth, the upper and lower lateral keel with a spine each. Abdomen sculptured by transverse furrows. . *P. carinicauda.*

1. Pontophilus cataphractus (Olivi) 1792.[10]

Cancer cataphractus Olivi, Zool. Adriat., 1792, p. 50, pl. 3, fig. 1.

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[10] Recently there has been described a species by Henderson (Trans. Linn. Soc. London, Zool. (2) V, part 10, 1893, p. 446, pl. 40, fig. 16. 17) from the Burmese coast named *Aegeon orientalis*, which is said to be nearly related to the Mediterranean *P. cataphractus*.

Egeon loricatus Risso, Hist. Nat. Europ. mérid., V, 1826, p. 58.
Crangon cataphractus (Oliv.) Milne-Edwards, Hist. Nat. Crust., II, 1837, 343, and Atlas in Cuvier, Regn. anim. pl. 51, fig. 3 (no date). Hel Crust. südl. Europ., 1863, p. 230, pl. 7, fig. 12–15. Miers, Annal. M Nat. Hist. (5) VIII, 1881, p. 365. Carus, Prodrom. faun. medit., I, 1884, 482.
Aegeon cataphractus (Oliv.) Ortmann, Zoolog. Jahrb., V, 1890, p. 535.

Geographical distribution: Mediterranean Sea (Risso, Milne-Ed wards, Heller, Carus); Senegambia (Miers).

2. Pontophilus bengalensis (Wood-Mason and Alcock) 1891.

Crangon bengalensis Wood-Mason and Alcock, Ann. Mag. Nat. Hist. (6 VIII, 1891, p. 360. Alcock and Anderson, Journ. Asiat. Soc. Bengal, vol 63, 2, 1894, p. 152.

Geographical distribution: Indian Seas, 107–276 fath. (Wood-Mason, Alcock, Anderson).

3. Pontophilus andamanensis (Wood-Mason and Alcock) 1891.

Crangon andamanensis Wood-Mason and Alcock, ibid.

Geographical distribution: Indian Seas, 188–220 fath. (Wood-Mason and Alcock).

4. Pontophilus echinulatus (M. Sars) 1861.

Crangon echinulatus M. Sars, Forh. Vid. Selsk., Christiana, 1861, p. 29, pl. 3. fig. 48–64. G. O. Sars, Arch. Math. Naturv., II, 1877, p. 339. Henderson, Decap. Schiz. Firth of Clyde, 1886, p. 33.
Crangon serratus Norman, Rep. Brit. Assoc., 31 meet., 1862, p. 151. Norman, ibid., 38 meet., 1869, p. 265.
Cheraphilus echinulatus (M. Sars). G. O. Sars, Forh. Vid. Selsk., Christiana, 1887, No. 18, p. 44. G. O. Sars, Den Norsk. Nordh. Exped., Zool., Crust., II, 1886, p. 7.

Geographical distribution: Norway, 80–150 fath. (M. Sars, G.

Pontophilus norvegicus (M. S.) Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 200. Smith, Trans Connectic. Acad., V, 1879, p. 60. G. O. Sars, Forh. Vid. Selsk., Christiania, 1882, No. 18, p. 7. Smith, Bull. Mus. Compar. Zool., Cambridge, X, 1882, p. 34. G. O. Sars, Den Norsk. Nordh. Exp. Zool. Crust., II, 1886, p. 7. Ortmann, Zoolog. Jahrb., V, 1890. p. 534.

Geographical distribution: Northern Atlantic.—Sweden: Bohuslan (Goës); Skagerrak, 320 fath. (Meinert); Norway, 30–500 fath. (M. Sars, G. O. Sars); Spitzbergen Sea (G. O. Sars); N. E. coast of America: Nova Scotia, 101–110 fath., Gulf of Maine, 115 fath., off Cape Cod, 105–524 fath. (Smith).

7. **Pontophilus brevirostris** Smith, 1881.

Smith, Proceed. U. S. Nation. Mus., III, 1881, p. 435. Smith, Bull. Mus. Compar. Zool. X, 1882, p. 35, pl. 7, fig. 1. Smith, Rep. U. S. Fish Com. for 1882–1884, p. 362.

Geographical distribution: Atlantic, eastern coast of United States, 51–155 fath. (Smith).

8. **Pontophilus abyssi** Smith, 1884.

Smith, Rep. U. S. Fish Com. for 1882–1884, p. 363. Wood-Mason and Alcock, Annal. Mag. Nat. Hist. (6) VIII, 1891, p. 361.

Geographical distribution: Atlantic, off the coast of United States, 37° N. Lat., 70° W. Long., 1917–2221 fath. (Smith); Bay of Bengal, 1748–1997 fath. (Wood-Mason and Alcock).

9. **Pontophilus occidentalis** Faxon, 1893.

Faxon, Bull. Mus. Compar. Zool., XXIV, 1893, p. 200.

Geographical distribution: Off the western coast of Central America, 978–2232 fath. (Faxon).

10. **Pontophilus challengeri** Ortmann, 1893.

Pontophilus gracilis Bate, Challenger Macrur., 1888, p. 487, pl. 87 (nomen praeoccupatum).
Pontophilus batei Faxon, Bull. Mus. Compar. Zool., XXIV, August, 1893, p. 200, footnote (nomen praeoccupatum).
Pontophilus challengeri Ortmann, Decapod. Schizop. Plankton Exped., 1893, September) p. 49.

Geographical distribution: Atlantic, near Tristan da Cunha, 1900 fath. (Bate); Cape Verde Islands, ca. 2700 fath. (Ortmann); Pacific: New Zealand, 1100 fath. (Bate); near Torres Strait, 1400 fath. (Bate); near Philippine Islands, 2150 fath. (Bate).

11. **Pontophilus pattersoni** (Kinahan) 1862.

Cheraphilus pattersoni Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 69, 73, pl. 7.

Geographical distribution: Northern England and Ireland (Kinahan).

12. Pontophilus sculptus (Bell) 1853.

Crangon sculptus Bell, Hist. Brit. Crust., 1853, p. 263 (fig.). Henderson, Decapod. Schizop., Firth of Clyde, 1886, p. 32.

Geographical distribution England: Weymouth (Bell), Firth of Clyde, 20 fath. (Henderson).

13. Pontophilus bidentatus (de Haan) 1849.

Cranzon bidentatus de Haan, Faun. Japon. Crust., Dec, 6, 1849, p. 183, pl. 44, fig. 14.

Geographical distribution: Japan (de Haan).

14. Pontophilus australis (Thomson) 1878.

Crangon australis Thomson, Trans. Proceed. New Zealand Inst., XI, 1878, p. 231, pl. 10, fig. A. 1. Filhol, Passage Venus., Miss. Campbell, III, 2, 1885, p. 430.

Geographical distribution: New Zealand: Cook Straits, Dunedin, Stewart Isl. (Thomson), from Napier to Stewart Isl. (Filhol).

15. Pontophilus junceus Bate, 1888.

Bate, Challenger Macrur. 1888, p. 491, pl. 88, fig. 2–4.

Geographical distribution: Between Philippine Islands and Borneo, 250 fath. (Bate.)

16. Pontophilus gracilis Smith, 1882.

Smith, Bull. Mus. Comparative Zool., X, 1882, p. 36, pl. 7, fig. 2–3. Wood-Mason andAlcock, Annals and Mag. Nat. Hist. (6) VIII, 1891, p. 361.

Geographical distribution: Atlantic, eastern coast of United States, 225–458 fath. (Smith); Bay of Bengal, 561–683 fath. (Wood-Mason and Alcock).

17. Pontophilus profundus Bate, 1888.

Bate, Challenger Macrur. 1888, p. 490, pl. 88, fig. 1.

Geographical distribution: Off Sydney, 2600 fath. (Bate).

18. Pontophilus bispinosus Hailstone, 1835.

Pontophilus bispinosus Hailstone (nec Westwood), Mag. Nat. Hist., VIII, 1835, p. 271, fig. 30.
Crangon nanus Kröyer, Naturh. Tidsskr., IV, 1842, p. 231, pl. 4, fig. 15–28. Metzger, Jahresber. Comm. Unters. Deutsch. Meer., II, III, 1875, p. 291. Meinert, Naturh. Tidsskr. (3) XI, 1877, p. 199. Henderson, Decap. Schiz. Firth of Clyde, 1886, p. 33. Scott, Annal. Mag. Nat. Hist. (6) XIII, 1894, p. 413.
Crangon bispinosus (Hailst.) Bell, Brit. Crust., 1853, p. 268.
Cheraphilus bispinosus (Hailst.) Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 68, 72, pl. 5.

Geographical distribution: Northern Europe.—Sund (Meinert); Kattegat (Kröyer); Skagerrak, 10–110 fath. (Meinert); Norway (G.

O. Sars); North Sea (Metzger, Scott); England (Bell, Kinahan, Henderson).

9. **Pontophilus intermedius** (Bate) 1863.

Crangon intermedius Bate, Proceed. Zool. Soc., London, 1863, p. 503, pl. 41, fig. 6. Haswell, Catal. Austral. Crust., 1882, p. 181.
Crangon batei Kingsley, Bull. Essex Inst., 14, 1882, p. 129.

Geographical distribution: Australia, Gulf St. Vincent (Bate).

0. **Pontophilus trispinosus** Hailstone, 1835.

Pontophilus trispinosus Hailstone, Mag. Nat. Hist., VIII, 1835. p. 261, fig. 25. Ortmann, Zoolog. Jahrb., IV, 1890, p. 533.
Crangon trispinosus (Hailst.) Bell, Brit. Crust., 1853, p. 265. Metzger, Jahresb. Comm. Unters. Deutsch. Meer., II, III, 1875, p. 291. Carus, Prodrom. faun. Medit., I, 1884, p. 482.
Cheraphilus trispinosus (Hailst.) Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 69, 72, pl. 6.

Geographical distribution: North Sea, 10–22 fath. (Metzger); England and Ireland (Kinahan); Marseille (Gourret); Azores (Barrois).

1. **Pontophilus fasciatus** (Risso) 1816.

Crangon fasciatus Risso, Hist. Nat. Crust., Nice, 1816, p. 82, pl. 3, fig. 5. Risso, Hist. Nat. Europ. mérid., V, 1826, p. 64. Milne-Edwards, Hist. Nat. Crust., II, 1837, p. 342. Bell. Brit. Crust., 1853, p. 259. Heller, Crust. südl. Europ., 1863, p. 228, pl. 7, fig. 10. Carus, Prodrom. faun. Medit., I, 1884, p. 483. Norman, Annal. Magaz. Nat. Hist. (5) XIX, 1887, p. 90.
Aegeon fasciatus (Riss.) Kinahan, Proceed. R. I. Acad., Dublin, VIII, 1862, p. 69, 74, pl. 9. Ortmann. Zoolog. Jahrb., IV, 1890, p. 535.

Geographical distribution: European Seas (Northern Europe, Mediterranean Sea) and Azores. (See Ortmann, l. c.).

22. **Pontophilus neglectus** (G. O. Sars) 1882.

Cheraphilus neglectus G. O. Sars, Forh. Vid. Selsk., Christiania, 1882, No. 18, p. 45, Pl. 1, fig. 7. G. O. Sars, Den Norsk. Nordh. Exp., Zool., Crust., II, 1886, p. 6.

Geographical distribution: Norway, 2–6 fath. (G. O. Sars).

23. **Pontophilus carinicauda** (Stimpson) 1860.

Crangon carinicauda Stimpson, Proceed. Acad. Nat. Sci. Philadelphia, 1860, p. 25.

Geographical distribution: Hong Kong (Stimpson).

SABINEA Owen, 1835.

Owen, Append. Voy. Capt. Ross, 1835, p. 82. Kingsley, Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 412.

Second pereiopoda very short, without chela. Gills seven, like *Pontophilus*, or five pleurobranchiæ and two arthrobranchiæ (see Smith, *Sabinea hystrix*). Eyes present, free.

a_1. Rostrum short, scarcely longer than the eyes.
  b_1. Rostrum and telson blunt . . . . *S. septemcarinata* (6).
  b_2. Rostrum and telson more acute . . . . *S. sarsi.*
a_2. Rostrum long, about as long as the antennale scale . . *S. hystrix.*

1. **Sabinea septemcarinata** (Sabine), 1824.

Crangon septemcarinatus Sabine, Suppl. Append. Parry's Voy. 1824, p. 236, pl. 2, fig. 11–13. Milne-Edwards, Hist. Nat. Crust. II, 1837, p. 343.
Sabinea septemcarinata (Sab.) Kröyer, Naturh. Tidsskr. IV. 1842, p. 244, pl. 4, fig. 34–40, pl. 5, fig. 41–44. Metzger, Jahresb. Comm. Unters. deutsch. Meer. II, III, 1875, p. 291. Miers, Ann. Mag. Nat. Hist. (4) XX, 1877, p. 58. Kingsley, Bull. Essex Inst. X, 1878, p. 55. Smith, Trans. Connect. Acad., V, 1879, p. 57, pl. 11, fig. 5, 9. 13. Hoek, Niederl. Arch. Zool., Suppl. 1, 7, Crust. 1882, p. 12. G. O. Sars, Den Norsk. Nordh. Exp. Zool. Crust. II, 1886, p. 7. Stuxberg, Vega Exped., V, 1887, p. 54. Bate, Challenger Macrur. 1888, p. 493, pl. 89, fig. 2, pl. 90, fig. 1. Ortmann, Zoolog. Jahrb., V, 1890, p. 536.

Geographical distribution: Arctic seas extending southward into boreal seas.—Norway, to 106 fath. (M. Sars, Metzger); Barents Sea and Nowaja Semlja, 37–160 fath. (Hoek); Spitzbergen (Kröyer, G. O. Sars); Iceland (Kröyer); Greenland (Reinhardt, Lütten); Davis Strait (Sabine); Grinnell Land (Miers); N. E. coast of America: from Gulf of St. Lawrence to Massachusetts Bay, 25–85 fath. (Smith, Bate); Arctic coast of Siberia (Stimpson, Stuxberg).

2. **Sabinea sarsi** Smith, 1879.

Smith, Trans. Connect. Acad., V, 1879, p. 59, pl. 11, fig. 6, 7, 8. G. O. Sars, Forh. Vidensk. Selsk. Christiania, 1882, No. 18, p. 46. Smith, Rep. U. S. Fish Comm. f. 1882, 1884, p. 364.

Geographical distribution: Northeastern coast of America, 60–150 fath. (Smith); Norway: Lofoten (Smith), Christianssund and Stavanger (G. O. Sars).

3. **Sabinea hystrix** (A. Milne-Edwards), 1881.

Paracrangon hystrix A Milne-Edwards, Annal. Sci. Natur. (6) Zool. XI, 1881, p. 6.
Sabinea princeps Smith, Bull. Mus. Comp. Zool. X, 1882, p. 38, pl. 8, fig. 1. Smith, Rep. U. S. Fish Comm. f. 1882, 1884, p. 364.

Geographical distribution: Atlantic: eastern coast of United States, 464–888 fath. (Smith); Guadeloupe, 734 fath. (A. Milne-Edwards).

PRIONOCRANGON Wood-Mason and Alcock, 1891.

Wood-Mason and Alcock, Annal. Mag. Nat. Hist. (6) VIII, 1891, p. 361.

Second pereiopoda present, without chela, rather robust with a fringe of long hairs. Eyes and eye-stalks wanting. Carapace with a spiny median keel.—Gills unknown.

Only one species known.

1. **Prionocrangon ommatosteres** Wood-Mason and Alcock, 1891.

Wood-Mason and Alcock l. c. p. 362. Alcock and Anderson, Jour. Asiat. Soc. Bengal, Vol. 63, 2, 1894, p. 152.

Geographical distribution: Bay of Bengal, 200–405 fath. (Wood-Mason, Alcock, and Anderson).

PARACRANGON Dana, 1852.

Dana, U. S. Explor. Exped. Crust. 1852, p. 537. Kingsley, Proceed. Acad. Nat Sci., Philadelphia, 1879, p. 412.

Second pereiopoda wanting. Eyes present, free. Carapace with long spines.—Gills unknown.

a_1. Branchial regions not areolate, five—spinous . . . *P. echinatus.*

a_2. Branchial regions traversed by anastomosing ridges, dividing these regions into cells of different sizes; they are armed with three small spines . . . . *P. areolatus.*

1. **Paracrangon echinatus** Dana, 1852.

Dana, U. S. Explor. Exped. Crust. 1852, p. 538, pl. 33, fig. 6. Stimpson, Boston Jour. Nat. Hist. VI, 1857, p. 497. Kingsley, Bull. Essex Instit. X, 1878, p. 55.

Geographical distribution: W. coast of North America: Puget Sound, Oregon (Dana).

2. **Paracrangon areolatus** Faxon, 1893.

Paracrangon areolata Faxon, Bull. Mus. Comp. Zool. XXIV, 1893, p. 200.

Geographical distribution: Western coast of Mexico: Tres Marias Islands, 676–680 fath. (Faxon).

Considerations concerning the geographical distribution of the Crangonidæ.

The geographical distribution of the *Crangonidæ* shows that only one genus, *Pontocaris*, no doubt the most primitive, is a true inhabitant of the lesser depths of the tropics, the two species known being found in 49 and 140 fathoms in the Indo-Malaysian seas. All the other genera are partly confined to the seas of temperate or cold climates, partly there is the main range, and only a few species are present in the litoral of warmer climates. *Pontocaris*, I believe, must be regarded as a survival in the tropics, and its occurrence in somewhat deeper water, but within the limits of the litoral, shows already the tendency to descend into greater depths developed in many species of the other *Crangonidæ*. None of the other species present in the tropical parts of the world can be regarded as survivals; they immigrated thither from the more northern localities.

The main range of the genus *Crangon* comprises the cooler seas of the northern hemisphere both in the Atlantic and Pacific. There are three species showing a true circumpolar distribution: *Cr. salebrosus*, *boreas* and *crangon*. The two first named must be regarded as true arctic animals, extending southward, it is true, in more temperate climates, but preferring considerable depths, from about 100 to 400 fathoms. *Crangon crangon* lives in very shallow water, extending not as far northward as *Cr. salebrosus* and *boreas*, and a connection between the Atlantic and Pacific (Japanese) localities is not known. Perhaps such a connection was only present in former times, and this species can not be counted among the circumpolar ones, but is a survival of a formerly more extended distribution. The two varieties of *Crangon crangon* described above prefer deeper water, 50 and 60 fathoms, and they are restricted to one of the northern parts of the two great oceans, *affinis* being found in the northern Pacific from Japan to California, *allmanni* in northern Europe. Of the other species of *Crangon* eight show a distribution similar to the two last varieties. Five are litoral and restricted to the northern part of the Pacific, especially *Cr. sharpi* and *intermedius* to the most northern parts (Berings Sea and Alaska), *Cr. angusticauda* to Japan, and *Cr. munitus* and *franciscorum* to the western coast of United States. The latter replaces the typical *Cr. crangon* on this coast. A sixth species, *Cr. agassizi*, is found in the Atlantic near the eastern coast of United States, and must be regarded as a true deep sea animal, being recorded from about 200 to 900 fathoms. It is replaced on the western side of America by a nearly allied abyssal species, *Cr. procax*, 660–900 fathoms. On the western coast of Central America is found a second abyssal species, *Cr. atrox*, between 600 and 700 fathoms, being closely related to the northern circumpolar *Cr. salebrosus*. The presence of these three abyssal species on both sides of the American continent indicate a relation to the northern circumpolar seas, according to their affinities with the northern circumpolar species of the subgenus *Sclerocrangon*, but I do not believe that this demonstrates the connection of the western and eastern American seas in the tertiary period within the litoral, as held to-day generally by authors.

Finally there are two antarctic species: *Cr. capensis* from the Cape of Good Hope, and *Cr. antarcticus* from South Georgia. The latter is regarded by Pfeffer[11] as a proof of the bipolar distribution of *Crangon*. I have doubted the correctness of Pfeffer's opinion in this view,[12] and have pointed out that the examples of bipolar distribution of crustacea enumerated by him do not correspond exactly to the facts known, except in the case of *Cr. antarcticus*. But neither in this species, is, I believe, a bipolarity of the genus probable. *Cr. antarcticus* is the nearest allied to *Cr. franciscorum* and this fact induces me to suppose that a connection between the northern and southern range of *Crangon* is present along the west coast of America from California to Chili, and in the same manner, I believe, there is a connection from the European seas along the western coast of Africa to the Cape of Good Hope, the locality of *Cr. capensis*. Litoral species of *Crangon* have not yet been recorded from the western coasts of America and Africa, but I hope that further investigation will demonstrate the presence of this genus in both localities, and thus strengthen my theory.

Supposing my theory to be correct, the range of *Crangon* would be a northern circumpolar one, partly containing circumpolar species, partly species confined to the northern parts either of Pacific or of Atlantic. Some species descended into the deep sea to a depth of about 900 fathoms and could propagate more southward. Along the west coasts of Africa and America, owing to the cooler temperature of the seas on these coasts, the range of *Crangon* could extend to the southern hemisphere, crossing the tropics.

The range of the genus *Nectocrangon*, the nearest allied of *Crangon*, agrees wholly with that of the northern species of *Crangon*: one species, *Nectocrangon lar*, is a true arctic-circumpolar one extending very little southward (the most southern locality recorded is Nova Scotia), the other, *Nectocrangon alaskensis*, is restricted, as we know, at present to Alaska.

The genus *Pontophilus*, the first of the series, representing the second branch of development arising from *Pontocaris*, has a nearly cosmopolitan horizontal distribution, but the several species are wholly different from each other. The greatest number of species, like *Crangon*, is found in the litoral of the cooler seas of the northern hemisphere, but their range does not extend very far northward. Accordingly, arctic circumpolar species are not known, the northern litoral species being restricted to comparatively narrow districts, each to one side of the great oceans. Only one species, *P. norvegicus*, in the northern Atlantic, is found on both the European and American shores. Eight species are found in the European seas: *P. echinulatus, spinosus, pattersoni, sculptus, bispinosus, trispinosus, fasciatus, neglectus*; one on the east coast of United States : *P. brevirostris*. As the cooler waters of the western African coast allow a more southward extension, a mediterranean species, *P. cataphractus*, ranges southward to the Senegambia. In the Pacific northern species are not known, but two having a more southward range: *P. bidentatus* in Japan, *P. carinicauda* in China. The presence of the latter in the tropics is due, I believe, to a more recent immigration. Of the northern litoral species some show a very large bathymetrical range, descending to considerable depths, especially *P. echinulatus, brevirostris* to 150 fathoms, *P. norvegicus* to 500 fathoms. The next to the latter species, as regards the depth inhabited, are *P. bengalensis, andamanensis, junceus*, being found in the tropical seas of India and Indo-Malaysia in depths of about 100 to 300 fathoms, and, farther, five species are true deep sea animals. One of these, *P. profundus*, is only found near Sydney in 2,600 fathoms, another, *P. occidentalis*, off the west coast of Central America in 900–2,200 fathoms. The three others show the characteristic wide range of the true abyssal animals, *Pont. gracilis* being found in the Atlantic and southern hemisphere is given the possibility to re-ascend into the litoral, and two litoral species are, in fact, found in Australia and New Zealand.

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[11] Pfeffer, Die niedere Thierwelt des antarctischen Ufergebietes.—Internat. Polarf. Deutsch. Exped. II, 1890, p. 520–572.

[12] Ortmann, Jenaische Denkschriften, VIII, 1894, p. 77.

The genus *Sabinea* contains two northern species, one of which, *S. septemcarinata*, is a true arctic circumpolar one, the other, *S. sarsi*, is found on both sides of the northern Atlantic. Both descend into greater depths, to about 150 fathoms. The third species, *S. hystrix*, is an abyssal one, found in 400 to nearly 900 fathoms, and its range extends more southward, from the eastern coast of United States to Guadeloupe in the West Indies.

The two known species of the most extreme genus of the second branch of Crangonidæ, *Paracrangon*, live on the western coasts of America, probably in greater depths; at least *P. areolatus* is recorded from over 600 fathoms.

The last genus, *Prionocrangon*, is very peculiar and its affinities are not certainly known. It probably is allied to *Pontophilus*, and then its habitat, in the deep sea of the Indian ocean, 200–400 fathoms, would not be strange, since *Pontophilus* contains also tropical species living in deeper water.

The distribution of *Crangonidæ* may be thus summarized:

The "regions of life"[13] in which Crangonidæ are found, are the *litoral* and the *abyssal*. Regarding the "facies,"[14] the Crangonidæ are principally, as we know, *benthonic*[15] in sand and mud. These habits admit a universal distribution of the family, but the genera and species are more restricted.

The litoral species especially are not cosmopolitan, but are confined by barriers. Except the tropical genus *Pontocaris*, which must be regarded as a survival, the litoral Crangonidæ are almost exclusively limited to the northern hemisphere, and the seas of tropical temperature must be considered as the *climatic barrier* preventing the distribution of Crangonidæ southward. Only a few species are adapted to the warmer seas, especially *Crangon cataphractus* in Senegambia and *Pontophilus carinicauda* in China, Generally, the Crangonidæ, originating in the cooler northern hemisphere, were separated from the cooler parts of the southern by the broad belt of the warm circumtropical seas. This zone, however, is not a continuous one, but is interrupted within the litoral on two tracts, on the western coasts of Africa and America. At these two localities there are two causes producing a lower temperature of the litoral seas than is usual in the tropics. On the one hand, there are cold currents running from the southern cold seas along both shores northward as far as the equator and even beyond; on the other hand, on these coasts arises cold water from the sea-bottom, the equatorial currents directed from the coast to the west carrying away the surface water. A cooling of the litoral waters of the west coasts of Africa and America is thus produced, and although the most superficial layers of water may be warmed by the sun, in greater depths within the litoral there may prevail a low temperature. Thus, on the west coasts of Africa and America, it may be possible that northern litoral forms penetrate into the tropics and beyond, and may reach the litoral of the cooler antartic hemisphere. The presence of *Crangon capensis* and *C. antarcticus* may be thus explained.

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[13] "Lebensbezirke," J. Walther, Bionomie des Meeres, 1893, p. 13–15, p. 87–176.—Walther does not give a satisfactory and correct definition of this word, on account of which his detailed discussion concerning this term is wholly out of place. Notwithstanding, the idea of "regions of life" is a very good one.

[14] Walther, ibid. p. 25–34.

[15] See Haeckel, Planktonstudien, 1890, p. 18ff.

By adaption to a cooler temperature a large number of Crangonidæ are able to descend to greater depths,[16] and by this habit they may enter and cross the tropics in the deep sea. The species adapted to the greater depths show, as usually in deep sea animals, a very large horizontal range, and, therefore, they can reach the southern hemisphere, while a re-ascending into the litoral of the antarctic regions is possible. We know of the genus *Pontophilus*, which is the only one containing true deep sea species of wide distribution, two species in southern Australia and New Zealand, the presence of which is probably due to this cause.

of the Pacific and Atlantic are inhabited by different species. Only the true arctic species being able to live along the most northern shores of America and Asia show a circumpolar distribution, no topographic barriers of the kind mentioned there being present. The species not living in the arctic, but in the boreal[17] seas, are restricted by such topographic barriers.

It is evident, therefore, that the means of dispersal of the Crangonidæ, except *Pontocaris* and a few species of *Pontophilus*, do not act against the climatic barriers and mostly also not against the topographic. Only a few known species are present on both shores of the Atlantic: *Pontophilus norvegicus* (100–150 fath.) and *Sabinea sarsi* (60–150 fath.). Whether these species can pass over the barrier formed by the northern Atlantic as adult animals or as larvæ, or whether this distribution is due to other causes, we can not say at present.

On the shores of the Atlantic and Pacific very nearly allied species are sometimes found. These must be derived from common ancestors living when the arctic ocean was not as cold as at present, and when a circumpolar connection was present for these species as in the case of the circumpolar forms now living. Later these species retreated more southward, and by the topographic separation of the range, the morphological characters could change, and distinct forms could develop.

The geographical distribution of the Crangonidæ is a very characteristic one and important as limiting the northern zoo-geographical regions of the litoral. Apart from a few species living in the tropics, in the antarctic and in the deep sea, the family of Crangonidæ characterizes the *northern circumpolar region*, as defined by me formerly.[18] This region is characterized by the genera *Nectocrangon* and *Sabinea*. Among the northern species we can distinguish true arctic species showing a circumpolar range, especially *Crangon salebrosus*, *boreas*, *Nectocrangon lar*, *Sabinea septemcarinata*, and boreal species. The latter are not circumpolar, but more restricted. *Crangon crangon affinis* is restricted to the Pacific, *Pontophilus norvegicus* and *Sabinea sarsi* to the Atlantic. The other species are more localized and characterize each a separate local fauna, and we can distinguish a Japanese fauna, a fauna of the Berings Sea, a fauna of the western coast of

[17] Regarding the distribution of "arctic" and "boreal" seas see Pfeffer, Versuch, etc., 1891.

[18] Jenaische Denkschriften, VIII, 1894, p. 78.

America. Characteristic of the first is *Crangon angusticanda; Pontophilus bidentatus;* of the second, *Crangon sharpi, C. intermedius, Nectocrangon alaskensis;* of the third, *Crangon munitus, C. franciscorum, Paracrangon echinatus.*[19] In the Atlantic, we have species peculiar to the European coasts: *Crangon crangon allmanni, Pontophilus echinatus, P. spinosus, P. pattersoni, P. sculptus, P. bispinosus, P. trispinosus, P. fasciatus, P. neglectus,* and one peculiar to the east coast of America: *Pontophilus breviorostris.*

Accordingly, within the limits of the arctic region we can distinguish three sub-regions: 1. The *arctic-circumpolar*; 2. the *Atlantic-boreal*; 3. the *Pacific-boreal.* The two latter are divided into local faunas, the Atlantic into the northern European and the fauna of the east coast of United States; the Pacific into the local faunas of the Berings Sea, of Japan, and of the west coast of North America.

The arctic litoral region is the centre of origin of the family of Crangonidæ, and the centre of its development. The geographical distribution of the species not living within the arctic litoral may be characterized and classified as follows:

1. Survivors of a more cosmopolitan distribution in the tropics of Indo-Malaysia: *Pontocaris propensalata, P. pennata.*

2. Immigrants into the litoral of warmer seas from the northern litoral: *Pontophilus cataphractus, P. carinicauda.*

3. Immigrants into the deep sea.

a. Localized species.[20] North Atlantic: *Crangon agassizi,* 200–900 fath., *Sabinea hystrix,* 400–900 fath.; Indo-Malaysia: *Pontophilus*

The occurrence of the recently described *Aegeon orientalis* Henderson, from the litoral of the Burmese coast (Gulf of Martabem) is remarkable, because this species is said to be related to the Mediterranean *Pontophilus cataphractus*. It may, however, belong to the genus *Pontocaris*, and the description and figure given by Henderson do not refute this supposition.

DOES THE DELAWARE WATER GAP CONSIST OF TWO RIVER GORGES?

BY EMMA WALTER.

The Delaware River passes through the Kittatinny or Blue Mountain by a cleft nearly at right angles to the axis of that range. The entire length of the cut is a little over two miles, but only to the part where it is narrowest or its walls highest and steepest is the term "Water Gap" locally applied. In the following paper, when the Gap is mentioned the entire two miles is included.

It is clear this remarkable breach in the mountain has been made by river water, and that it is still being deepened by the Delaware, as is stated in the Reports of the Pennsylvania Geological Survey.

But a study of the marked features of the Water Gap has convinced me the Delaware once flowed through it from the south towards the north, or in a direction directly opposite to the present flow of the river; also that this north-flowing river was preglacial and that much the larger part, both of the length and depth of of the Gap, was cut by this old river, the remainder being the work of the present south-flowing river since the Ice Age, the Delaware Water Gap being thus composed of two united river gorges, which our Delaware. Near the northern entrance to the Water Gap are low rapids, over the Clinton rocks; just after the river accomplishes its passage through the mountain it falls in a succession of low rapids over the Hudson River slates.

For many miles both above and below these two sets of rapids the average depth of the water is only six feet, according to the Geological Survey, but between them, about a mile and three-quarters below the upper, and a quarter of a mile above the lower rapids, is a spot where the river has a surprising depth; no two authorities agree concerning the number of feet. In 1892 the engineer of the little launch which plies to and fro in the Gap, said: "It is 35 feet deep." L. W. Brodhead writes me: "We took soundings about forty years ago and made it 45 feet;" and he adds, "a sounding some years previous reached 60 feet, while a century earlier it was thought to be unfathomable." In Penna. Geol. Sur. Rept's., Vol. G6, the depth is given as 51 feet, while a local Guide Book gives 70 feet.

Two agencies are, no doubt, slowly lessening this remarkable depth. The gradual cutting down of the whole river bed from this point to sea level and the slow filling of the pool, by the debris dropped into its quiet waters in times of freshet.

At the north entrance of the Water Gap the bed of the river is nearly 1,500 feet wide; in half a mile it has contracted to 400 feet and in the next mile reaches its narrowest, 350 feet. This portion is nearly a quarter of a mile in length, its walls, 1,000 feet high, rise at an average angle of 45°. From 350 feet the channel suddenly widens to an oblong pool 500 feet wide and about 900 feet long. This pool is bounded by nearly 900 feet of Pennsylvania shore which rises, steeply, to a height of 1,100 feet. The New Jersey side stretches in a beautiful curve, 2,100 feet long, and rises in part a sheer precipice of 1,000 feet, with 200 feet of steep rock still above that. This great curve rounds to the south and ends suddenly at the Point of Rocks. It is just opposite this point and not far from the New Jersey shore, the extraordinary, deep water before described is found. Here, I believe, is the centre of the amphitheatre of the gorge of the north-flowing Delaware and this deep pool marks the spot where the waters of the great river plunged into the chasm. But the solid rock wall over which they fell has been breached by a channel 400 feet wide. Through this opening the Delaware enters that portion of the Water Gap that I believe is the work of the present south-flowing river.

Nor is the character of the part of the Gap just described the only evidence that the Delaware River in pre-glacial times flowed to the northward.

In Vol. G6, page 53, we read, "finding an old buried valley bed from Port Jervis northeastward to the Hudson River at Rondout, * * * the suggestion seemed not unreasonable that the Delaware turned northeastward at Port Jervis and, receiving a large tributary from the south, kept along this old buried valley to the Hudson River. "But," the report continues, "subsequent study of the Delaware Valley, southward * * * seemed to render this view uncertain, since the Delaware appears to have flowed through the Kittatinny Mountain, at the Water Gap, during its entire history."

I think it is clear "the Delaware has flowed through the Gap during its entire history," but that the direction of the flow of the river through the Gap in pre-glacial times was exactly the reverse of its direction since the glacier disappeared.

In Vol. D3, of Penn. Geol. Sur. Rept's., two remarkable patches of gravel are described. One is at West Bethlehem, the other at Easton. Both lie at a height of 170 feet above the present level of the water in the Delaware at Easton. Upon this gravel rests a boulder clay which contains scratched stones, gravel and clay, together having a thickness of from 25 to 30 feet. The irregularities of the upper line of the gravel are great and show it was worn into ward would meet the glacier long before the ice reached the Gap. Possibly the river might find, for a time, a side escape for its waters, without turning back upon itself. As Prof. J. P. Lesley says, on page 1,203 of Summary, Final Report, Penn. Geol. Sur. "the Delaware River seems to have flowed in different ages along different lines." When the ice at length filled the Gap, which is about twenty-three miles above Easton, then the river waters would be ponded back upon themselves and all the debris carried by the stream, still flowing from the south, would be dropped where the currents meet. When the ice finally reached its southern limit, marked by the terminal moraine which lies 12 miles above Easton, then, what H. Carvill Lewis, in his "Glacial Geology of Great Britain and Ireland," styles an "extra-moraine lake" would be formed. For he says: "when glacier or moraine obstructs a stream flowing from outside towards the glacier a lake may be formed in the non-glaciated area bordering the moraine. Such lakes are only temporary and are drained when the river has established its new channel." "At first thought," Mr. Lewis continues, "it seems a remarkable feat for a river to suddenly begin flowing backward and up stream; but I can show that this feat was actually accomplished in many cases, both in America and England," and farther, "a river having begun to flow backward while the ice barred its forward progress, continued to do so after the ice-wall had retreated and the terminal moraine took its place." On another page we read in the same work, "when a stream was dammed back by the front of the ice, there boulder clay full of scratched erratics accumulated, filling the old river valley."

The change in the direction of the flow of the Delaware was no doubt accelerated by the general change in the level of the land which we know accompanied the Ice Age, an elevation at the north and a depression at the south. In "Glacial Geol. G. Brit. and Ire." before quoted, it is stated, "there was in Pennsylvania a subsidence of 180 feet at tide-water. The rivers then emptied much further inland and their channels were much shorter and relatively steeper than now and thus their cutting power would be largely increased." The great volume of water loaded with debris which must have issued from the melting ice sheet would also add greatly to the rapidity with which a new channel would be cut.

In a note in 2d Geol. Surv. Penna. Rep't, Vol. L, Prof. J. P.

Lesley calls attention to the curious fact that the gravel deposit at Easton stands nearly upon the same level with the highest of the Upper Delaware terraces above that river.

The terraces of the Upper Delaware are a marked and beautiful feature of its scenery. They are found between Port Jervis and the Water Gap, often as four regular steps. The first or lowest is from 20 to 25 feet above the river, while the fourth or highest terrace stands at 150 feet above the present river level. Five terraces are all well marked along Brodhead's Creek, the principal tributary of the Delaware between Port Jervis and the Water Gap. They can also be traced up the "great buried valley" in which the sluggish stream known as Cherry Creek flows to enter the Delaware just below the mouth of Brodhead's Creek and just above the northern entrance to the Gap.

In Report L, Prof. Lewis says, "these terraces of the Upper Delaware may be due to an ancient obstruction in the Gap backing up the water from the melting glacier to form a lake of considerable size." That these terraces are of later formation than the glacial deposits is proved on Brodhead's Creek, where a railroad cutting shows kames partly covered by terrace material.

Now it will be remembered their positions are directly reversed at Easton; there the glacial material lies on the top of the river terrace, showing that the terrace there is the older deposit of the two.

If the rock in the centre of the amphitheatre of the pre-glacial gorge had not been cut down to present river level, when the glacier retreated this rock-wall would certainly stand as "an ancient obstruction in the Gap, damming back the waters to form a lake of considerable size," or from Port Jervis to the Water Gap. In this lake the waters would rise until they reached the top of the rock-wall and pouring over it the draining of the lake would begin. So the highest terrace of the new river would come to stand nearly upon the same level as the lowest or last of the old river, the new standing at 150 feet and the old at 170 feet above the present water level in the river. Does this difference of 20 feet represent the sum of the fall of the bed of the old river between Easton and the Water Gap and the amount of the erosion by the ice between the same points?

In Vol. L, page 58, H. Carvil Lewis says, "it was a surprising and unexpected fact to find no tongue of ice was projected through the Gap, which was, as it were, ignored by the glacier. It filled the

Gap up with ice but moved diagonally across it." Glacial striæ all pointing in a direction obliquely across the mountain and the Gap, occur at various heights and on the top of the mountain, but no striæ were noted below the Kittatinny House. This hotel stands upon the 120 foot contour line of Chance's map, though according to Mr. Brodhead it is 180 feet above the river and is situated just below the north entrance to the Gap.

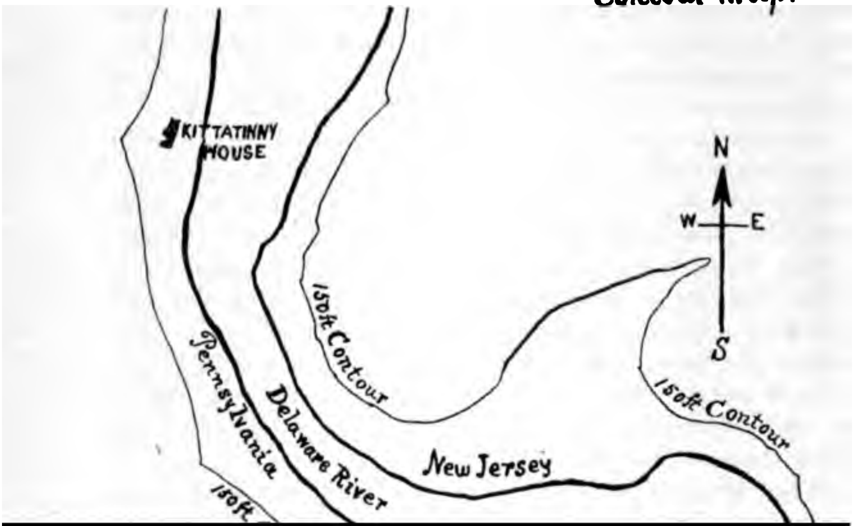
Above the carriage road, on the Pennsylvania side, not far from the narrowest part of the gorge, a series of beautiful, polished, horizontal grooves of considerable size may be seen; on the perpendicular face of the sand-stone rock, Mr. L. W. Brodhead gives the height of these grooves above river as 150 feet. Their course is nearly at right angles to the direction of the glacial striæ on the mountain.

Whether these are glacial grooves, or whether they are, as seems to me most probable, the result of a swift current of water carrying much debris, they certainly show that a powerfully erosive agent of some kind passed through the Gap at about the height of 150 feet. Now at this same height stands the upper terrace of the present river, while not far above the same elevation lies the old river gravel, and glacial striæ appear to be absent below a nearly equal level. The position of grooves, terrace, old river gravel and absence of glacial striæ, so nearly on the same line, is explained, if the rock wall of the centre of the amphitheatre stood somewhere near a height of 150 feet at the end of the Ice Age.

When the water commenced to flow over this rock-wall it would begin the cutting of the short lower, or south portion of the Gap. Its walls are very precipitious for a short distance and the gorge ends rather suddenly, as the southeastern face of the Kittatinny Mountain is exceedingly bold. This lower gorge extends from the Point of Rocks to the head of the rapids over the Hudson River slates. The width of the channel where the river passes from the upper gorge to the lower, as before stated, is 400 feet, but it increases to 800 feet at its wide-spreading mouth. This very rapid curving outward of the walls of the lower gorge, on both sides of the river so nearly alike, seems to indicate the impetuous rush of an immense body of water.

The difference in the character of the bed of the present river from Port Jervis to the beginning of the Hudson River slates and from the beginning of the Hudson River slates to the

A map of the
Delaware Water Gap.
Reduced from
Chance's
Contour Map.



moraine at Belvidere, I think offers further proof that the first mentioned portion was cut before the coming of the ice sheet, and the last since the melting of the ice; for from Port Jervis to the slates the Delaware flows in a deep, ancient river valley or valleys. Its bed, except at a few points where there is a rock bottom for a short distance, is in the glacial drift which still fills the old water course to an unknown depth, even the deepest portion of the Gap itself being so filled, while from the beginning of the slates to Belvidere, the river has a rock bed, its channel is broad, the valley wide, with hills rising only one or two hundred feet above the river.

Looking southward from the top of Mt. Minsi, on the Pennsylvania side of the southern entrance to the Gap, from a height of 1,100 feet, the country has the appearance of a gently sloping plain nearly to Belvidere, 13 miles away. The fall in the river in this distance is 4½ feet per mile, while in the unglaciated area between Belvidere and Easton the descent is 6½ feet per mile. This fall, with the vast volume of water which must have continually poured through the Gap during the melting of the ice, would certainly, I think, give a torrent of sufficient force to accomplish the work which I have assumed has been done since the melting of the ice sheet.

If I have proven that the gorge from the Point of Rocks to the northern entrance of the Gap was the work of a north-flowing river, and the gorge from the Point of Rocks to the southern entrance of the Gap is the work of the south-flowing Delaware, it follows that the Delaware Water Gap *does* consist of two river gorges united, eroded from different directions and in different geological epochs.

NEW SPECIES OF THE GENUS CERION.

BY H. A. PILSBRY AND E. G. VANATTA.

Mr. C. J. Maynard has lately made known certain characters of the internal teeth or lamellæ of the species of the genus *Cerion* found by cutting the shell open. By this means, many species considerably alike externally are found to be well distinguished when their interiors are examined. Mr. E. G. Vanatta having engaged to make the necessary sections, a considerable portion of the Cerions of the Academy's collection has been thus reviewed, and various new species brought to light, some of which may be briefly diagnosed as follows, further information and figures being reserved for a future communication :—

Cerion (Paracerion) tridentatum Pilsbry and Vanatta.

Shell similar externally to *C. incanum*, but aperture long, ovate, much higher than wide ; cone of spire longer, several whorls following the nepionic ones densely striate. Parietal lamina small, short, central, with a smaller accessory denticle to the left of and beyond its inner end, and another lamina slightly to the right and deeper within. Alt. 25-27½ ; diam. 9-10 mm. Cuba, R. Swift.

The section *Paracerion* P. and V. is proposed for forms having reflexed, thin; parietal lamina strong, short; axial lamina inconspicuous in front. Alt. 28; diam. 12 mm. Cat Island, Bahamas.

This species and the next are peculiarly unlike all others known in being densely, conspicuously spirally striated.

Cerion (Maynardia) Johnsoni P. and V.

Shell turreted, elongate, *the last whorl widest, the others forming a tapering spire*, the earlier whorls of the form seen in a young Eucalodium. *Surface densely spirally striate*, and bearing very stout, distant ribs; 11 on penult., one or two fewer on earlier whorls. Whorls 11½, *very convex.* Aperture about one-third the alt., oval-cordate; parietal lamina small. Color cream-white. Alt. 32; diam. 11 mm. Locality unknown; one specimen from coll. C. W. Johnson.

This is really the most remarkable form of *Cerion* yet discovered, allied to *C. felis* in sculpture, but in the tapering contour wholly unlike anything known hitherto in the genus, with the exception of *Pupa scalarina* Gundl., which is much smaller, with less attenuated earlier whorls.

Cerion (Maynardia) columna P. and V.

Shell thick, strong, cylindrical or column-shaped, the latter 4-5 whorls of equal diameter, those preceding forming a cone of one-fourth the shell's length; bluish-white, flesh-tinged on cone, some whorls of which are finely, closely striate; the striæ then either disappear, leaving the median whorls smooth, or become coarse, wide-spaced, irregular costæ on median whorls, stronger on last whorl. Whorls 13, hardly convex. Aperture small, less than one-third the alt., long-ovate, gothic-angular above; interior deep purple-brown, often becoming red-brown toward the white lip, which is everywhere revolutely reflexed, but not thickened. Parietal tooth strong and (for a *Maynardia*) long. Axial lamina moderate. Alt. 46½; diam. 12½ mm. Inagua.

Differs from the closely allied *C. infanda* in the smaller and colored aperture, less compressed body-whorl, etc.; from *C. regina* it differs in the more elongate form, colored mouth and less excavated umbilical tract; from *C. regium* in the more slender contour, etc. It resembles in shape, *Pupa cretacea* Pfr.; but that species is far more obtuse than any of the dozen specimens of this before us. A variety which may be called v. *valida* is smaller, strongly and subregularly costate throughout. Inagua. Alt. 34; diam. 10½ mm.

Cerion (Maynardia) regina P. and V.

Shell like *C. regium* Bens. in form, color, and the expanded, excavated umbilical area; lip narrower; ribless except on the last whorl, which has few irregularly spaced ribs, or in some specimens uneven, sparse ribs are found throughout the cylindrical portion. Parietal tooth short. Alt. 30-33½; diam. 12 mm. Turk's Island (Swift, Gabb).

This species has affinities with *C. columna* of Inagua, *C. regium* of Castle Island, *C. lentiginosum* and *C. album* of Rum Cay. The first is more elongated and pillar-like, with very dark mouth; the second is stouter, heavier, with far wider, thicker lip—in fact, a lip of quite Ethiopian characteristics; and the two forms from Rum Cay are distinguished from all the preceding by the close, even microscopic costulation of their earlier whorls.

C. regina percostatum P. and V.

Form of shell and mouth as in *C. regina;* but whole surface except nepionic apex, regularly ribbed, as in *Strophia alba* Mayn., except that the ribs on cylindrical portion are wider spaced. White, much mottled and clouded with brown. Holds the same relation to *C. regina* that *album* holds toward *lentiginosum*. Alt. 35½; diam. 13 mm.; often smaller in the same proportions or comparatively wider. Mouth longer than in *C. album* Mayn. Turk's Island.

Cerion regina comes P. and V.

Shell with the form, size and sculpture of *C. regina*, but coloring of *C. lentiginosum* Mayn.; heavily streaked and blotched with chest-

Cerion regina brevispira P. and V.

Shell short, pupiform, compact; lower two whorls of equal diameter, those above tapering to form a short cone. Whorls 8-9, all but the last one smooth, the last more or less ribbed; umbilical chink deep, the area below it excavated. Aperture much exceeding one-third the length of shell, ovate, purple within; peristome narrowly reflexed, not thickened, white; parietal callus imperceptible; parietal lamina small, rather short, deep-seated. Axial lamina small. White, boldly streaked and blotched with rich brown. Alt. 22, diam. 10 mm. or smaller. Apert., alt. 9.5; width 8.3 mm. Turk's Island. (W. M. Gabb.)

This form looks very distinct from *C. regina*, and we have no intermediate specimens; but it occurs on the same small island, and may prove to be only a sub-species of that form.

Cerion (Maynardia) maritimum var. sublævigatum (Pfr.) P. and V.

Similar to *maritima*, but lacking costulæ. Matanzas, etc., Cuba. (*Strophia maritima* Maynard, Monogr. p. 127, seems to be this, rather than the typical *maritima*.)

Cerion (Maynardia) abacoensis P. and V.

Shell like *Cerion album* Maynard in form, sculpture and color, or rather shorter; differing in the more closed, shallower, far shorter umbilical rimation and very much smaller umbilical area behind columellar lip, and in the thicker lip. Alt. 32; diam. 12½ mm.; alt. 27½; diam. 13 mm. Abaco I. (Bland.).

Cerion (Maynardia) incanoides P. and V.

Shell resembling *C. incanum* in general aspect. Very thin; cylindrical, the lower three whorls of equal diameter, those above forming a convex, obtuse cone. Surface nearly smooth, as in *S. incana;* white or fleshy-white, the two nepionic whorls corneous brown, the following whorls of cone finely variegated with zigzag brown marking and speckling. Whorls 10, almost flat. Aperture ovate-truncate, brown inside; parietal lamina low and rather short; axial lamina sharp, strong within last whorl, but not over a whorl long; peristome narrowly reflexed, white, thin; parietal callus rather thin; umbilical rimation deep, sometimes perforate, the area below it broad, excavated, flaring. Alt. 30; diam. 11 mm.; alt. of apert. 11; diam. 9 mm. Turk's Island.

This species belongs clearly to the group of *C. regina*, *lentiginosum*, etc., but it is a very thin shell, smooth like *incana*, with which it has probably been confused in collections.

Cerion (Maynardia) Maynardi P. and V.

Shell large, strong, cylindrical, white or fleshy in the intervals between strong, slightly curved ribs, separated by three times their width on the cylindrical portion, which consists of 3 to 4 whorls; those above forming a short cone on which the ribs are much closer. Whorls 11½, flat, the last ascending, becoming attenuated downward, but with well rounded base, upon which the ribs are obsolete, but replaced by fine costulæ. Umbilical rimation very deep, the area below it rather wide, bounded by a spiral groove well within the basal margin of umbilical tract. Aperture ovate-truncate, brown within; parietal lamina very strong, thick but short; axial lamina small, one whorl long. Peristome stout, broadly reflexed, its face convexly thickened but not "duplicate;" broadly vaulted over the umbilical region; parietal callus varying from thin to heavy. Alt. 35; diam. 15 mm.; apert. alt. 14; width 12 mm. Some specimens fall under, some exceed these dimensions. Abaco, Bahamas. (Robert Swift.) Larger and coarser than *C. abacoensis*, and with far deeper umbilical rimation and distant ribs.

Cerion (Maynardia) yumaensis P. and V.

Shell cylindrical, the lower three whorls of equal diameter, those above tapering rapidly to form a short cone; white, mottled with fleshy-corneous

APRIL 2, 1895.

The President, GENERAL WISTAR, in the Chair.

Forty-six persons present.

Mr. Henry A. Pilsbry was elected a Curator for the unexpired term of the late Dr. W. S. W. Ruschenberger.

APRIL 9.

The President, GENERAL WISTAR, in the Chair.

Twenty-four persons present.

The following minute was presented from the Biological and Microscopical Section and unanimously adopted :

JOHN A. RYDER, PH. D.

In view of the death of our colleague, Dr. John A. Ryder, it is the sense of the Biological and Microscopical Section of the Academy of Natural Sciences of Philadelphia that a minute be recorded to express the great regret of the Section and its deep appreciation of the loss it has sustained in his untimely decease.

Dr. Ryder was elected a member of the Academy of Natural Sciences of Philadelphia January 29, 1878, and shortly after that date began to attend the meetings of the Section and frequently made interesting communications. He became a member of the Section November 15, 1886, and at the annual meeting in the same year he was chosen Director, which office he held until the close of 1888. Many of his communications made before the Section were verbal and were, to a large extent, a resumé or report of his own current work, and also of that of other investigators at home and abroad, who were working in lines similar to his own. The subjects treated in these communications included myology, embryology, histology, microscopic technique, malacology, comparative anatomy and kindred biological studies. Most of these communications afterward appeared in print in the Proceedings of the Academy or elsewhere.

Dr. Ryder's earnestness of purpose and intense interest in his studies could not fail to impress and stimulate his fellow members, while his wonderful memory and obliging disposition were often appealed to by them, and it was very rarely that he could not furnish the desired information. Especially was this true of his knowledge and recollection of scientific literature; on many subjects he could give an almost complete bibliography from memory.

In deeply deploring the early death of Dr. Ryder, which occurred at the height of his scientific vigor, the Section but voices the sentiment of the entire biological world.

(Signed)

HAROLD WINGATE,
AMOS P. BROWN,
H. F. MOORE, } *Committee.*

APRIL 16.

The President, GENERAL WISTAR, in the Chair.

Thirty-four persons present.

The deaths of the following Correspondents were announced:—

John Whitaker Hulke, of London, G. B.; Gaston de Saporta, of Aix, Germany, and James Dwight Dana, of New Haven, Conn.

The following papers were presented for publication:—

New species of the genus Cerion. By Henry A. Pilsbry and E. G. Vanatta.

Notes on Varying Hares of Washington and British Columbia, with description of a new subspecies. By Samuel N. Rhoads.

APRIL 23.

The President, GENERAL WISTAR, in the Chair.

Thirty-one persons present.

A paper entitled "Distribution of the American Bison in Pennsylvania, with remarks on a new fossil species," by Samuel N. Rhoads, was presented for publication.

APRIL 30.

The President, GENERAL WISTAR, in the chair.

Twenty-seven persons present.

A paper entitled "On the Priority of the names Calliste, Aglaia and Calospiza and their use in Ornithology," by Witmer Stone, was presented for publication.

Mr. Thomas Meehan was appointed Chairman of the Publication Committee to succeed the late Mr. Redfield.

Dr. Samuel G. Dixon was appointed a member of the Library Committee to succeed the late Dr. Ruschenberger.

Messrs. Persifor Frazer, Angelo Heilprin, J. P. Lesley, Benj. Smith Lyman and Theodore D. Rand were appointed members of the Hayden Memorial Geological Committee.

Mr. William W. Jefferis was appointed Curator of the William S. Vaux Collections.

The following were ordered to be printed:

DESCRIPTIONS OF NEW SPECIES OF ACHATINELLIDÆ FROM THE HAWAIIAN ISLANDS.

BY D. D. BALDWIN.

At the present time the total number of described species of *Achatinella*, after eliminating the *Auriculella* and *Leptachatina*, is about 330. Of these 102 are manifest synonyms or varieties. Some of the remaining species are closely allied, and nearly all exceedingly variable.

In the past twenty years only five species have been added to the list, though during this period several new regions have been explored and many new forms discovered. Strange as it may appear, large districts remain yet to be explored: These will require much research, as well as considerable time before the molluscan life and its exact distribution can be fully ascertained, for the habitats of the *Achatinella* are our lofty and rugged mountains, covered with almost impenetrable forest jungles, and furrowed by deep gorges, often difficult of access, a species being often restricted to a single isolated mountain ridge or gorge.

The inconstant and variable characters which many of the species of *Achatinella* exhibit, the uncertainty of some of the species already published, and the somewhat confused synonymy of the group, all contribute to render difficult the matter of affirming new species. Of great importance is the geographical position or distribution of a species. Differences in the external appearance and color of the animals furnish specific tests of essential value. Peculiarities in the sculpturing and color of the earlier or embryonic whorls have proved of value in determining some of the species. An experience also of over forty years in collecting and studying the habitats and distribution of *Achatinella* may be to some extent a guarantee for the validity of the new species herewith presented.

We are indebted to Rev. Prof. Gwatkin, of Cambridge, England, and Mr. H. Suter, of New Zealand, for notes regarding the lingual dentition of the species of *Achatinella*. They indicate two very distinct divisions of the genus, as founded on the structure of the radula.

Section first. No jaw; only a chitinous, transparent membrane covering the lips. Radula broad, oblong. Teeth of the radula very numerous, en chevron, rows sloping obliquely backward; the central tooth long and slender, often obsolete; the laterals and marginals all of the same type, base narrow, head rather broad, the denticles varying in number from five to seven, in the last marginal from four to two.

To this section belong the following subgenera of *Achatinella*, viz.: *Achatinellastrum* Pfr.; *Bulimella* Pfr; *Apex* von Martens; *Partulina* Pfr.; *Newcombia* Pfr.; and *Eburnella* and *Perdicella* of Pease. The species of these subgenera are all arboreal in their habit, and their dentition is practically indistinguishable, except that in some species the central tooth is absent or slightly varied.

Section second. Jaw present; arcuate, strong, not ribbed. Radula oblong, not wide. Teeth quadrate, in nearly straight rows; centrals small, narrow, sometimes faintly tricuspid; laterals larger, bicuspid; marginals bicuspid or multicuspid.

To this section belong the subgenera *Amastra* H. & A. Ad., and *Laminella* Pfr. The species of the former are terrestrial, and those of the latter either terrestrial or living on low shrubs. The differences in the number of teeth are small, and the variations of shape trifling.

It thus appears that in the majority of the generally accepted subgenera of *Achatinella* there is no possibility of separating the sections by differences in the form of dentition. The terrestrial species, or those tending to terrestrial habits, are characterized by the presence of a jaw; the arboreal species, by its absence. The group *Amastra*, including perhaps *Laminella*, are entitled to separate generic rank.

Section ACHATINELLASTRUM Pfeiffer.

Achatinella multizonata, n. sp. Pl. X, figs. 1, 2.

Shell dextral, imperforate, moderately solid, elongately conical, apex subacute, surface shining, striated with fine lines of growth, under a strong lens showing very numerous, extremely minute decussating striæ; apical whorls smooth, scarcely decussated. Color white, variously striped with numerous dark brown lines and bands, some on the base and others spiral. Whorls 6, lightly marginate above, convex; suture lightly impressed. Aperture oblique, oval, white, the dark bands of the exterior visible within; peristome acute, thickened within, slightly expanded, white, the dark lines of the exterior marked on the inner edge; columella purplish brown, terminating in a strong, oblique, tortuous fold.

Length, 18; diam., 10 mm.

Habitat, Nuuanu Valley, Oahu.

Animal, when extended in motion, longer than the shell. Mantle brown, lighter on the outer edge. Foot above and below light brown; posterior portion tapering. Tentacles long and slender; these, with the head above, slate color.

A great variety of transition forms occur between this species and *A. bellula* Smith, which is found on the neighboring mountain ridges of Nuuanu Valley, and is a much larger shell. The animals of the two extremes are specifically different. The mantle of the latter is black, whereas that of the former is brown, and that of the intermediate forms varies from black to brown.

Achatinella Juddii, n. sp. Pl. X, figs. 3, 4.

Shell dextral, imperforate, solid, pyramidally conical, apex obtuse; surface shining, covered with very delicate incremental lines; the nuclear whorls smooth. Color light gray, shading into light chestnut on the apical whorls, the gray more intense under the cuticle; with two black lines, one below and one at the periphery, the latter faint and continued on the spire; between the lines a white band which revolves on the suture to the very tip of the apex. Whorls 6, margined above, slightly convex; suture lightly impressed. Aperture oblique, oval, white, the light gray of the ex-

Achatinella Ernestina, n. sp. Pl. X, figs. 5, 6.

Shell sinistral, subperforate, moderately solid, ovately conical; apex subacute; surface shining, obliquely striated with delicate growth lines, under a strong lens exhibiting numerous, very close, and minute decussating striæ; apical whorls smooth, scarcely decussated. Color yellow, lighter above; variously striped with transverse, dark chestnut bands, the more constant being one bordering the suture, one at the periphery, spiral above, and one encircling the base. Whorls 6, narrowly margined above, somewhat convex; suture moderately impressed. Aperture oblique, oval, faintly exhibiting the dark bands of the exterior; peristome acute, somewhat thickened within, slightly expanded, white, the coloring of the exterior bands appearing on the inner edge; columella white, terminating in a prominent, oblique, tortuous fold.

Length, 21; diam., 12 mm.

Habitat, Nuuanu Valley, Island of Oahu.

The animal, when extended in motion, as long as the shell. Mantle light brown, sprinkled with black and margined on the outer edge with an interrupted reddish-yellow line. Superior portion of foot light brown, thickly studded with small slate spots; under portion of foot light brown with a slate tinge. Tentacles dark slate.

This species is found near the mountain ridge separating the habitats of *A. castanea* Rve. and *A. fuscolineata* Smith; and in general appearance and characters it is intermediate between these species. It is much smaller than the former and rather larger than the latter, and differs from them both in the arrangement of colors. Transition forms between it and both of them are numerous. An item of specific value is the difference in the exterior appearance and color of the animals.

Section BULIMELLA Pfeiffer

Achatinella luteostoma, n. sp. Pl. X, figs. 7, 8.

Shell sinistral, imperforate, solid, ovate, spire convexly conical, apex obtuse; surface shining, marked with fine growth lines, under a strong lens seen to be decussated by close, extremely minute spiral striæ, apical whorls smooth. Color white, with a reddish-yellow lip. Whorls 5½, margined above, slightly convex. Suture moderately impressed.

Aperture oblique, sinuately oval, white within. Lip obtuse, thickened within, columellar margin very slightly reflexed, extremities united by a very thin yellowish callus. Columella reddish yellow, terminating in a strong tortuous fold.

Length, 15½ ; diam., 9½ mm.

Habitat, Palolo to Niu, Island of Oahu.

It is *Bulimella rosea* Swains, *var.* Hartman, Proceedings Academy of Natural Sciences of Philadelphia, Jan. 31, 1888, p. 30.

In occasional examples the basal portion below the periphery is light brown, and sometimes a bright chestnut spiral band encircles the periphery.

Dr. Hartman, in his valuable Synonymic Catalogue of *Achatinella*, has noted this species as a small variety of *A. rosea* Swains. When we sent him the shell we were unacquainted with the animal. This proves very different from that of *A. rosea;* and further, the habitats of the two species are separated by a forty mile range of wild mountain ridges and valleys which do not contain any species intermediate or connecting the two.

Achatinella Lyonsiana, n. sp. Pl. X, figs. 9, 10, 11.

Shell sinistral, imperforate, solid, ovate; spire convexly conical, apex obtuse ; surface shining, striated with delicate growth lines ; apical whorls smooth. Color white, with two reddish-brown bands, one encircling the base, the other passing around the periphery and revolving on the spire just above the suture ; the two bands are sometimes confluent, and often the shell is uniform white, without

Achatinella is given in the preface to this article. The species has a central tooth which is long and slender, with a small reflection and two minute cutting points. (H. Suter.)

This distinct species is dedicated to Prof. A. B. Lyons, of Oahu College, who has done much to stimulate the study of the Hawaiian land fauna.

Achatinella Lymaniana, n. sp. Pl. X, figs. 12, 13.

Shell sinistral, very minutely perforated, solid, ovate; spire convexly conical, apex subacute; surface shining, covered with fine incremental lines, under a strong lens showing minute decussating striæ; apical whorls smooth, when not eroded. Color dark purplish brown, sometimes with longitudinal or transverse white flecks or zigzag lines; a white line traversing the suture; apex light chestnut. Whorls 6, very lightly margined above, somewhat convex; suture moderately impressed. Aperture oblique, white within, sublunate; peristome acute, thickened within, expanded, the columellar margin slightly reflexed and covering the small perforation, color white on both face and the reverse; columella white, terminating in a slightly developed flexuous fold.

Length, 20½; diam., 11½ mm.

Habitat, Waianae Mts., Island of Oahu.

No opportunity for an examination of the animal has yet occurred.

This species is typically very distinct from any other known species of the bulimoid section of *Achatinella*.

Named in honor of Mr. Ernest Lyman, to whom science is indebted for many additions to Hawaiian land shells.

Section APEX von Martens.

Achatinella vespertina, n. sp. Pl. X, fig. 14.

Shell dextral, minutely perforated, solid, globose, with the spire conical, lateral outlines slightly concave, apex subacute; surface shining, striated with delicate growth lines; apical whorls smooth. Of a uniform delicate cream color, lighter on the upper whorls and sutures; sometimes with a few faint, white transverse lines on the lower whorl. Whorls 6, narrowly margined above, the first three plain, the rest slightly convex, the last somewhat inflated; suture lightly impressed. Aperture very oblique, oval, white within; peristome white, acute, thickened within, somewhat expanded, the basal margin slightly reflected, the columellar margin forming a sinuou ridge around the umbilicus, extremities united by a very thin callosity; columella terminating in a strong, round, white tubercle.

Length, 21; diam. 14½ mm.

Habitat, Kawailoa, Island of Oahu.

Animal when extended in mòtion, longer than the shell. Mantle and tentacles brown, the latter with the head above, of darker shade. Foot light yellow, the superior portion of darker hue.

The nearest allied species is *A. Swiftii* Newc.; but the shape and color of the shell, separate habitat, and difference of animal, entitle it to rank as a distinct species.

The native Hawaiians firmly believe in the power of *Achatinella* to produce musical sounds. Hence the Hawaiian name, "*pupu kanioe*," singing shells. Their legends ascribe to them a vesper song.

Achatinella Cookei, n. sp. Pl. X, fig. 15.

Shell dextral, subperforate, solid, globose, with spire regularly conical, apex subacute; surface shining, marked with fine incremental lines; the apical whorls smooth. Color, basal portion below the periphery jet black or sometimes brownish black, the apex white, rest of the shell very light brown, darker on the sutural margin. Whorls 6, margined above, the first three plain, the rest convex, the last inflated; suture well impressed. Aperture very oblique, oval, white within; peristome obtuse, slightly thickened cal with that of *A. Cookei*, the latter must rank as a variety of the former.

Named in honor of Hon. C. M. Cooke, by whose sons the shell was discovered.

Section PARTULINA Pfeiffer.

Achatinella Dolei, n. sp. Pl. X, figs. 17, 18.

Shell sinistral, minutely perforated, somewhat solid, acuminately ovate conic, apex acute; surface shining, marked with delicate incremental striæ, under a lens exhibiting extremely close, minute, decussating spiral striæ; nuclear whorls faintly cross-lined. Color white, encircled below the periphery with a brownish black band, and at the periphery and above with more or less numerous, delicate, chestnut, spiral lines, which become fainter on the middle whorls and obsolete above. Whorls 6½, narrowly margined above, convex; the last somewhat inflated, roundly angulated at the periphery and flattened on the base; suture deeply impressed. Aperture oblique, roundly ovate, flattened on the basal margin, white, exhibiting the brown markings of the exterior; peristome acute, angled at the periphery, slightly thickened within, expanded, basal and columellar margins narrowly reflexed; columella terminating in a long, flexuous, white plait.

Length, 24½; diam. 14 mm.

Habitat, Honomanu, Island of Maui.

Animal when extended in motion longer than the shell. Mantle intensely black with a broad outer margin of yellow and a conspicuous orange spot in the center of the margin. Foot tapering behind, above and below light yellow. Tentacles long and slender, light slate. Head above lightly granulated.

The dentition of this and the preceding species, as observed by Mr. Suter, does not differ materially from that of the arboreal Achatinellas generally. In both of these species a long and slender central tooth is present.

We found this species very plentiful at the above locality, in the humid forests of the exterior slope of Haleakala crater, at an altitude of 7,000 feet above sea level. The dark band below the periphery is a constant feature. The nearest allied species is *A. splendida* Newc., of West Maui. It differs, however, from this in the sub-angulated periphery, flattened base, and untessellated upper whorls. The animals are also different, and the habitats widely separated.

We take pleasure in dedicating this beautiful shell to His Excellency S. B. Dole, First President of the Republic of Hawaii, a gentleman noted for attainments in natural as well as political science.

Achatinella nivea, n. sp. Pl. X, fig. 19.

Shell sinistral, subperforate, somewhat solid, acuminately ovate conic, apex acute; surface highly polished, obliquely striated with fine lines of growth, and under a lens showing very close and delicate decussating spiral striæ; nuclear whorls faintly decussated. Color white, encircled with a narrow, pale chestnut band on or a little below the periphery. Whorls 7, slightly marginate above, flatly convex, the last with a somewhat angular periphery and flattened base. Suture slightly impressed.

Aperture oblique, roundly oval, white, the chestnut band of the exterior visible within. Peristome white, acute, thickened within, expanded, basal and columellar margins narrowly reflexed, extremities joined by a very thin white callus. Columella white, terminating in a moderately developed, flexuous plait.

Length, 24; diam. 14 mm.

Habitat, Makawao to Huelo, Island of Maui.

Animal when extended in motion longer than the shell. Mantle densely black with minute brown flecks and a broad yellowish band encircling the outer edge. Tentacles and superior portion of foot brown with a slight slate tinge; under portion of foot light brown. Front above covered with light granulations.

I have before me over 500 examples of this species, which are without variety in color or shape. The peripheral chestnut band is a constant feature. It may be readily distinguished from *Achatinella Tappaniana* Adams, by its more slender form and convex spire, by the sub-angulated periphery, flattened base, and more polished surface. The color of the animals is also very different; and the habitats are separated by a twenty-five mile expanse of low dry land, which is destitute of forests and molluscan life. In character of shell and animal it has some affinity with the preceding species; and, considering the remote habitats, the two may be regarded as distinct, but allied species.

Achatinella mucida, n. sp. Pl. X, fig. 23.

Shell sinistral, very minutely perforated, solid, acuminately ovate conic, apex rather acute; surface shining, marked with fine growth lines, and under a lens decussated by very delicate, close, spiral striæ. The shell of an ashy gray color, irregularly distributed over the surface, giving it a mucid appearance; with a dark brown band at the periphery which becomes sutural, extending both above and below the suture, and a small patch of the same color around the umbilicus; also with a few inconspicuous brown lines on the base and above the periphery, the latter continued above; apical whorls generally denuded of cuticle, and then of a light chestnut color. Whorls 7, slightly convex; suture moderately impressed. Aperture oblique, oval, livid white within; peristome acute, slightly thickened within, expanded, basal and columellar margins narrowly reflexed, light brown on both face and the reverse; columella tinged with brown, terminating in a strong, plaited, projecting tooth.

Length, 21½; diam. 11½ mm.

Habitat, Makakupaia, Island of Molokai.

This species is found in the region intervening between the habitats of *A. Redfieldii* Newc. and *A. compta* Pse.; and it has characteristics connecting it with each of these species. It is smaller than either, and differs from both in the coloration, particularly from the former in the absence of the white sutural band.

Achatinella Ancoyana, n. sp. Pl. X, fig. 16.

Shell dextral, imperforate, rather thin, ovately conical, apex obtuse; surface shining, striated with fine growth lines, under a lens exhibiting a beautiful pattern of close, delicate, decussating, spiral striæ, which extend to the very apex. Color reddish brown, becoming paler towards the summit; with two yellow bands, a broad one encircling the umbilical region, a narrow one at the periphery, the latter margined above with a delicate white line, which is continued on the spire just above the suture and becomes lost on the third whorl; also with a narrow white line revolving below the suture to the very tip of the apex. Whorls 5, convex, not marginate; suture distinctly impressed. Aperture a little oblique, oval, white, distinctly exhibiting the dark coloring of the exterior; peristome acute, slightly thickened within, the coloring of the outside appearing on the inner edge; columella brown, terminating in a well developed, flexuous fold.

Length, 14½; diam. 9 mm.

Habitat, Makawao, Island of Maui.

Animal when extended in motion longer than the shell. Mantle light brown mottled with black, outer edge encircled with an interrupted orange band. Foot above and below a very light brown, superior portion with a slate tinge, posterior portion tapering and sometimes with a yellowish tinge. Tentacles long, light slate. Head above minutely granulated.

This species was collected in the forests of the exterior slope of the extinct Haleakala crater, at an altitude of 4,000 feet above sea level. Owing to its peculiar habit of living on the foliage near the tops of trees, it has escaped previous observation.

The species has no known congeners. It is remarkable for the constancy of its delicate color lines. Over 200 examples before me show only trifling divergence in this respect.

Named in honor of Mr. C. F. Ancey, whose publications have contributed largely to our knowledge of Hawaiian land shells.

Achatinella Horneri, n. sp. Pl. X, figs. 20, 21, 22.

Shell sinistral, minutely perforated, thin, globose with a short acutely conical spire, apex acute; surface shining, striated with fine incremental lines, and under a lens exhibiting very close and delicate decussating spiral striæ; embryonic whorls faintly cross-lined. Color dull white, encircled at the periphery with a faint brown zone which is continued on the suture, also with a very small patch of same color around the umbilicus. Whorls 6, the upper five slightly convex, the last very much inflated, forming the greater part of the shell; suture distinctly impressed. Aperture oblique, sub-rotund, very large, white within, distinctly showing the external peripheral band; peristome margined with light brown, rather thin, very slightly thickened within, expanded, basal and columellar margins narrowly reflexed, extremities slightly converging and united by a thin callus; columella light brown, very slightly developed, plain and smooth.

Length, 24; diam. 18 mm.

Habitat, Hamakua, Island of Hawaii.

Animal in motion longer than the shell. Mantle black, margined with gray. Foot above and below gray, the superior portions lightly granulated. Tentacles light gray.

There occurs also a pure white form of the shell without the peripheral band, and a form white with a light chestnut band on the apical whorls. The animals of these varieties vary only a trifle from that of the typical form.

This species belongs to the group of *A. physa* Newc., but is easily distinguished by its much more inflated body whorl and smaller spire, its smoother and polished surface. The habitats of the two species are widely separated, and the animals are entirely different. The animal of *A. physa*, mantle and foot, is a dingy white with a greenish yellow tinge.

We dedicate the species to Mr. J. Lewis Horner, the young naturalist to whom science is indebted for the discovery of this and the following species. They are valuable additions to the shells of the Island of Hawaii, which has heretofore furnished only one described arboreal species of *Achatinella*.

Achatinella Hawaiiensis, n. sp. Pl. X, figs. 24, 25, 26.

Shell sinistral, minutely perforated, very thin, acutely conical, apex acute; surface rather lusterless, covered with fine lines of growth, and under a lens showing extremely close and delicate decussating spiral lines; nuclear whorls faintly decussated. Color very variable, plain brown or dingy white, sometimes irregularly striped or mottled with brown and white, the base generally uniform brown, but sometimes with undulating markings of brown and white; the only constant characters being a brown, sometimes interrupted, line at the periphery, bordered below with a broader white line. Whorls 6, slightly convex, the last inflated. Suture lightly impressed.

Aperture oblique, oval, brown, the peripheral brown and white bands distinctly marked within. Peristome acute, not thickened within, external margin straight, basal expanded, the expanded portion being very thin and fragile, the columella margin reflexed over the minute perforation; color white on both face and the reverse. Columella white, very slightly developed, plain and smooth.

Length, 18; diam. 10½ mm.

Habitat, Hamakua, Island of Hawaii.

Animal when extended in motion longer than the shell. Mantle almost white, margin of a darker shade. Foot above and below dingy white, superior portion sometimes flecked with gray. Tentacles of darker shade.

The dentition is the same as that of the arboreal Achatinellas generally. A central tooth is present; and the formula of dentition is 125-1-125 × 120=30,120. (Prof. Gwatkin.)

This species also belongs to the group of *A. physa* Newc., but is readily distinguished by its much smaller size, smoother surface, delicate lip, and arrangement of colors. The habitats are also widely separated and the animals different.

Achatinella Theodorei, n. sp. Pl. X, fig. 27.

Shell sinistral, subperforate, rather thin, elongately conical, apex subacute; surface shining, sculptured with somewhat irregular incremental striæ, and under a lens exhibiting extremely close and minute decussating spiral striæ; nuclear whorls smooth. Color dingy white, striped and mottled irregularly with longitudinal dark brown streaks. Whorls 7, lightly marginate above, slightly convex; suture moderately impressed. Aperture oblique, oval, purplish brown within; peristome acute, margined with brown, very lightly thickened within, columellar margin slightly reflexed; columella terminating in a slight, flexuous, brown fold.

Length, 18½ ; diam. 9 mm.

Habitat, Kawela, Island of Molokai.

The animal has not as yet been observed. The shell belongs to the group of small elongately conical *Partulina* for which Mr. Harper Pease proposed the name *Perdicella* as a subgeneric title.

The nearest allied species is *A. ornata* Newc., which is of much smaller size, more delicate markings, has a peripheral dark band, and inhabits a different island.

Section NEWCOMBIA Pfeiffer.

Achatinella canaliculata, n. sp. Pl. X, figs. 28 29.

Shell sinistral, very minutely perforated, somewhat solid, acuminately turreted, apex subacute; surface sculptured throughout with numerous acute, spiral keels, which become blunter as they approach the apex, the interstices between the keels exhibiting under a lens very delicate growth striæ. Color brown, upper whorls tessellated with brown and white. Whorls 6, slightly convex, lower one somewhat flattened at the base; suture lightly impressed. Aperture oblique, oval, livid white or light brown within; peristome acute, very lightly thickened within, expanded, columellar margin reflexed over the small perforation, margined with light brown on both face and the reverse; columella very slightly developed, plain and smooth.

Length, 14; diam. 6½ mm.

Habitat, Halawa, Island of Molokai.

Animal when extended in motion as long as the shell. Mantle slate color, margined with brown. Foot light slate, studded on the sides and head above with spots of deeper shade. Tentacles short and slender, dark slate.

The nearest allied species is *A. sulcata* Pfr., from which it may be distinguished by its smaller size and more acute keels; the animals also differ and the habitats are widely separated.

Section LAMINELLA Pfeiffer.

Laminella helvina, n. sp. Pl. XI, fig. 30.

Shell sinistral, imperforate or subperforate, sometimes narrowly and deeply perforated, rather thin, elongately conical, apex rather acute; surface scarcely shining, covered with very fine incremental striæ; nuclear whorls smooth. Color uniform light or dingy yellow, with a few black markings on the upper whorls. Whorls 6½, lightly margined above, convex; suture deeply impressed. Aperture a little oblique, oval, white, with the tint of the outside; peristome simple, thin, margins connected by a thin, orange-yellow callus; columella biplicate, the terminal plication a thin, oblique lamellar plait, the inner one less prominent, tortuous, of an orange yellow color.

Length, 18; diam. 10 mm.

Habitat, Ohia valley, near Kaluaaha, Island of Molokai.

Animal extended in motion as long as the shell. Mantle and foot above and below very light brown. Tentacles dark slate, with a sprinkling of slate on the sides of the foot. Posterior portion of foot very tapering and thickly studded with minute red spots. A remarkably prolific species; 4 or 5 embryonic shells in successive stages of growth often observed in the oviducts. A jaw is present and the dentition is the same as that of the Amastra species. The tooth formula of this species is 32.1.32 × 108 = 7,020. The central tooth is a little wider than usual. (Prof. Gwatkin.)

This shell differs from all its congeners in its strongly biplicate columella, and the peculiar soft parts of the animal. The typical forms are found in the small valley of Ohia on Molokai. Departing from this locality on either side, modified forms without the biplicate columella are somewhat common.

Laminella depicta, n. sp. Pl. XI, figs. 33, 34, 35.

Shell sinistral, sometimes slightly perforated, rather thin, elongately conical, apex subacute; surface shining, striated with very delicate growth lines; nuclear whorls smooth. Color light yellow or reddish yellow, plain, or marked with numerous black, anastomosing veins; apex almost black in some examples. Whorls 7, faintly margined above, somewhat convex, suture distinctly impressed. Aperture a little oblique, oval, white or pinkish, the outside markings visible within; peristome simple, very thin; columella white, sub-biplicate, tortuous, abruptly terminating in a thin lamellar plait.

Length, 15½; diam. 6½ mm.

Habitat, Kamalo, Island of Molokai.

Animal extended in motion shorter than the shell. Mantle very light brown. Foot above and below almost white. Tentacles short, light brown.

This species is allied to *A. Alexandri* Newc., from the Island of Maui, and to *A. Remyi* Newc., from the Island of Lanai, but differs from both in the color and habits of the animal.

Section **AMASTRA** H. & A. Adams.

almost white with a slate tinge. Foot above and below almost white, the posterior portion and edges densely studded with very minute pink spots. Tentacles short, light slate, with a few spots of the same color on the head above.

All the Amastra species are terrestrial in their habits; their form of dentition is given in the preface to this article. The formula for this species is 28.1.28 × 99 = 5,645. (Prof. Gwatkin.)

Unlike most of the Amastra, which generally have dark dingy colored animals, this species has a beautiful, almost white animal. The after portion and edges of the foot under a lens are seen to be closely studded with minute pink spots which give these parts a delicate pink hue.

Amastra umbrosa, n. sp. Pl. XI, figs. 36, 37.

Shell dextral, imperforate, solid, globosely ovate-conic; surface lustreless, covered with close, rather regular growth striæ; the lower whorls spirally malleated; the embryonic whorls finely radiately sulcated. Color white, apex dark chestnut; nearly the whole surface covered with irregular streaks of a black, fugacious epidermis, worn off in front of the aperture. Whorls 6, slightly convex, the last somewhat inflated. Aperture ovate, a little oblique, white within; peristome acute, thickened within, expanded; columella white, flexuous, abruptly terminating in a somewhat thick lamellar plait.

Length, 21; diam. 12½ mm.

Habitat, Kamalo, Island of Molokai.

Animal extended in motion longer than the shell. Mantle dark brown with a margin of lighter shade. Foot light brown, the superior portion and sides studded with large spots of deeper shade. Tentacles short, stout, very dark brown.

The formula of dentition is 28.1.28. The marginals take a peculiar form. (Prof. Gwatkin.)

Amastra rubicunda, n. sp. Pl. XI, fig. 38.

Shell dextral, imperforate, rather solid, elongately ovate-conic; surface lustreless, striated with irregular growth striæ; embryonic whorls smooth. Color reddish, with traces of a deciduous, thin, brown epidermis. Whorls 7, slightly convex; suture well impressed. Aperture elongately oval, a trifle oblique, rather small, purplish red within; peristome simple, thin, margined with dark purple; columella white with a purple tinge, flexuous, abruptly terminating in a thin, slightly curved lamellar plait.

Length, 19; diam. 9 mm.

Habitat; Konahuanui Mt., Island of Oahu.

Animal, mantle brown, margin of a deeper shade. Foot brown, the superior portion almost black. The formula of the dentition is 18.10.1.10.18. (H. Suter.)

In form and general appearance this species resembles *Amastra variegata* Pfr., which inhabits a different station, and is readily distinguished by its less ruddy color, sulcated apex, and essential difference of animal.

Amastra undata, n. sp. Pl. XI, fig. 39.

Shell dextral, imperforate, solid, ovate, spire convexly conical, apex rather acute, base somewhat attenuated; surface lustreless, closely and rather evenly ribbed in the direction of the growth lines, the rib-striæ being slightly interrupted by several coarse, transverse spiral lines, the nuclear whorls finely radiately sulcated. Color light brown and dark chestnut, alternating in irregular longitudinal undulations. Whorls 6, slightly convex; suture moderately impressed. Aperture a trifle oblique, sublunate, rather small, white within; peristome acute, slightly thickened within; columella white flexuous, abruptly terminating in a thin, slightly arched, lamellar plait.

Length, 17; diam. 12 mm.

Habitat; Nuuanu, Island of Oahu.

This species is very rare and local in its distribution. Its principal features are the prominent rib-striæ and the beautiful undulating markings of light and dark chestnut brown.

Amastra badia, n. sp. Pl. XI, fig. 40.

Shell dextral, imperforate, rather thin, elongately ovate-conic; surface shining, sculptured with delicate, rather close thread-like rib-striæ in the direction of the growth lines; embryonic whorls radiately sulcated. Color dark chestnut-brown with light brown zigzag or undulating lines and markings. Whorls 6½, slightly convex; suture moderately impressed. Aperture oval, a trifle oblique, livid white within, exhibiting the brown color of the exterior; peristome acute, very lightly thickened within; columella white, flexuous, abruptly terminating in a thin, slightly arched lamellar plait.

Length, 20½; diam. 10½ mm.

Habitat, Ewa, Island of Oahu.

The distribution of this species, as far as observed, is quite limited. We do not know of any species approaching it in form or specific characteristics. Its somewhat smooth and polished surface distinguishes it from most of the species of the Amastra section.

Amastra pellucida, n. sp. Pl. XI, figs. 41, 42.

Shell dextral, imperforate, very fragile, thin, translucent, globosely conic, apex rather acute; surface lusterless, sculptured with fine incremental lines, apical whorls smooth. Color light-brown, apex darker; destitute of epidermis. Whorls 5½, somewhat convex; suture moderately impressed. Aperture oval, a trifle oblique, livid-white within; peristome simple, thin; columella white, flexuous, abruptly terminating in a thin lamellar plait.

Length, 12½; diam. 8 mm.

Habitat, Waianae Valley, Island of Oahu.

Animal of a uniform brown color; the head above and tentacles of a darker shade. The action of the heart is plainly visible through the thin texture of the shell. When first collected the pulsations were about fifty per minute, growing slower and fainter from day to day until the animal died.

This species is well characterized by its thin pellucid texture, globose form, abbreviated spire, and light brown color.

Amastra breviata, n. sp. Pl. XI, figs. 45, 46.

Shell dextral, very minutely perforated, rather thin, globosely conical, apex rather acute; surface not polished, covered with fine incremental lines, the nuclear whorls smooth. Color corneous-brown, destitute of an epidermis. Whorls 6, slightly convex; suture well impressed. Aperture a trifle oblique, oval, livid-white within, showing the color of the exterior; peristome simple, thin, extremities joined by a thin white or brown callosity; columella white, flexuous, abruptly terminating in a thin lamellar plait.

Length, 12½; diam. 7½ mm.

Habitat, Palolo and Halawa, Island of Oahu.

This shell approaches the preceding species in its form; but may be readily distinguished by its thicker texture and darker color. The habitats are also widely separated and the animals differ.

Amastra tenuispira, n. sp. Pl. XI, fig. 51.

Shell dextral, imperforate, solid, acuminately turreted, spire conical, apex subacute; surface lustreless, covered with somewhat rude, irregular incremental striæ; the embryonic whorls very finely, radiately sulcated. Color light-brown, upper whorls darker; covered with an earthy brown, fugacious epidermis. Whorls 7, somewhat convex, in some examples slightly margined above; suture well impressed. Aperture oval, oblique, rather small, light-brown within; peristome simple, acute, extremities united with a thin callosity; columella sub-biplicate, light-brown, tortuous, abruptly terminating in an oblique, dentiform plait.

Length, 17; diam. 6½ mm.

Habitat, Kaala Mt., Island of Oahu.

This species is very local in its habitat. Its only congeners are the elongate forms *Amastra Hutchinsonii* Pse., which inhabits East Maui, and *Amastra moesta* Newc. from the island of Lanai. The former is remarkable as the only known sinistral species of the Amastra section, and is also distinguished by its invariably white aperture and columella fold. The latter species is characterized by its more obese form and peculiar columella.

Amastra nana, n. sp. Pl. XI, figs. 48, 49.

Shell dextral, imperforate, rather thin, ovately conical, apex subacute; surface lustreless, striated with fine incremental lines, the 2½ embryonic whorls finely, radiately sulcated. The color varies *cuta* Pfr. from Oahu; species possessing entirely different characteristics.

Common, but very local in its distribution, in a belt of forest land about 4,000 feet above sea level.

Amastra antiqua, n. sp. Pl. XI, fig. 47.

Shell fossil, dextral, narrowly but deeply perforated, the perforation penetrating almost to the apex; solid, elongately ovate, apex subacute; surface sculptured with rude, irregular lines of growth, the apical whorls smooth. Color of the living shell unknown. Whorls 6, convex; suture well impressed. Aperture a trifle oblique, sublunate; peristome thickened within, columellar margin adnate, slightly expanded over the umbilicus, extremities somewhat converging and united by a thick parietal callosity; columella flexuous, terminating in a narrow plait.

Length, 20; diam. 12 mm.

Habitat, Ewa, Island of Oahu.

We received this species from Prof. A. B. Lyons, of Oahu College. He reports that he found at Ewa a singular accumulation of these and other fossil land shells, huddled together in one spot in a bed of soft tufa-like material, at an altitude not far above sea level. The existence of living examples of this and the following species now, or within any recent period, is highly improbable.

Amasta vetusta, n. sp. Pl. XI, fig. 50.

Shell fossil, dextral, imperforate, solid, ovately conical, apex rather acute; surface sculptured with somewhat regular, close rib-striæ in the direction of the growth lines, with a few faint cross lines; the embryonic whorls radiately sulcated. Color of living shell unknown. Whorls 6½, very slightly convex; suture lightly impressed. Aperture sinuately oval, a little oblique; peristome flatly blunt, thickened on the inner edge, margins united with a thick callosity; columella flexuous, abruptly terminating in a small, thin plait.

Length, 13; diam. 7½ mm.

Habitat, near Honolulu, Island of Oahu.

This species was also discovered by Prof. Lyons. It occurs near the base of Punchbowl Hill, at an altitude of twenty or thirty feet above sea level, in a conglomerate of volcanic tufa and sand cemented together with carbonate of lime. Prof. Lyons thinks the shells must have lived near the spot where they are now found embedded in the rock, as there is no satisfactory way to account for their transportation from any distance. If so, the conditions of climate when the shells flourished in that locality, must have been quite different from those of the present time.

Amastra cyclostoma, n. sp. Pl. XI, fig. 53.

Shell dextral, narrowly but deeply perforated, the perforation penetrating to the apex, somewhat solid, oblately globular with a short conical spire, apex acute; surface lustreless, sculptured with close, obliquely descending, flexuous growth lines, which become concentric around the umbilicus; the embryonic whorls smooth or with delicate, radiating sulcations. Color brown, darker on the spire. Whorls 6, the upper ones rather flat, rapidly increasing; the last one large, forming the greater part of the shell, strongly angled at the periphery, the angle becoming almost obsolete towards the aperture, deflexed in front a trifle below the carina, surface above the angle flat, slightly convex towards the aperture, and rounded below the angle; suture well impressed. Aperture very oblique, sinuately circular, a small segment cut off by the penultimate whorl, livid-white within, exhibiting the exterior coloring through its substance; peristome rather obtuse, slightly thickened within, unreflected, extremities slightly converging and united by a very thin callosity; columella livid-white, broad and flat, terminating in a slight, flexuous plait.

Altitude, 15; diam. 18 mm.

Habitat, Makaweli, Island of Kauai.

Animal when extended in motion .95 inch in length; posterior portion of foot tapering and very short, front portion long; head elongated, ocular and labial tentacles widely separated. Mantle dingy-white with streaks of black. Foot very light brown, superior portion and sides thickly studded with regular, dark brown granulations. Tentacles long, dark brown.

This species belongs to the same group as *Amastra sphaerica* Pse. and *Amastra heliciformis* Anc., but may be readily distinguished from both by its much larger size and more inflated body whorl.

Amastra Knudsenii, n. sp. Pl. XI, figs. 43, 44.

Shell dextral, imperforate, solid, elongately ovate, spire conical, apex subacute; surface lustreless, coarsely and irregularly wrinkled by growth striae; embryonic whorls very finely radiately sulcated.

Color very dark brown, tending to a lighter shade on the elevated portions of the lower whorl. Whorls 7, the three lower ones strongly angulated a little below the suture, the last one with a cord-like keel at the periphery and numerous coarse cross striæ above and below the periphery; suture well impressed. Aperture oblique, elongately oval, dark purple inside with a satin-like lustre; peristome acute, not thickened within; columella terminating in a long, narrow, flexuous, pearly-white plait.

Length 33; diam. 17 mm.

Habitat: Halemanu, Island of Kauai.

Both this species and *Amastra Kauaiensis* Newc. are characterized by the long, flexuous thread-like columellar plait which is peculiar to the genus *Carelia* of Kauai. Examination of the animals may prove them both aberrant forms of that genus.

The species is very rare. We dedicate it to Mr. A. Knudsen, the young naturalist who discovered it. He writes that it is of very limited distribution, being found far up the mountain only in an isolated tract of wood land which escaped the forest fires of twenty years ago. In three days' diligent search he found only twelve living examples.

EXPLANATION OF PLATES.

The figured types are, with the exceptions noted below, in the collection of the Academy of Natural Sciences, bearing the numbers quoted in parenthesis.

PLATE X.

FIGURES		
FIGS. 1, 2.	Achatinella multizonata Baldwin	(65,703)
" 3, 4.	Achatinella Juddii Baldwin	(65,709)
" 5, 6.	Achatinella Ernestina Baldwin	(65,706)
" 7, 8.	Achatinella luteostoma Baldwin	(65,704, 65,705)
" 9.	Achatinella Lyonsiana Baldwin	(65,693)
" 10.	Achatinella Lyonsiana var.	(coll. Baldwin)
" 11.	Achatinella Lyonsiana var.	(65,694)
" 12, 13.	Achatinella Lymaniana Baldwin	(coll. Baldwin)
" 14.	Achatinella vespertina Baldwin	(65,699)
" 15.	Achatinella Cookei Baldwin	(65,692)

Figures.			
"	16.	Achatinella Anceyana Baldwin	(65,707)
"	17, 18.	Achatinella Dolei Baldwin	(65,690)
"	19.	Achatinella nivea Baldwin	(65,691)
"	20.	Achatinella Horneri Baldwin	(65,702)
"	21.	Achatinella Horneri var.	(65,700)
"	22.	Achatinella Horneri var.	(65,701)
"	23.	Achatinella mucida Baldwin	(65,708)
"	24.	Achatinella Hawaiiensis Baldwin	(65,695)
"	25.	Achatinella Hawaiiensis var.	(65,696)
"	26.	Achatinella Hawaiiensis var.	(65,698)
"	27.	Achatinella Theodorei Baldwin	(65,710)
"	28, 29.	Achatinella canaliculata Baldwin	(65,713)

Plate XI.

Figures.			
"	30.	Laminella helvina Baldwin	(65,712)
"	31, 32.	Amastra pullata Baldwin	(65,715)
"	33, 34, 35.	Laminella depicta Baldwin	(65,711)
"	36, 37.	Amastra umbrosa Baldwin	(65,714)
"	38.	Amastra rubicunda Baldwin	(65,719)
"	39.	Amastra undata Baldwin	(65,722)
"	40.	Amastra badia Baldwin	(coll. Baldwin)
"	41, 42.	Amastra pellucida Baldwin	(65,721)
"	43, 44.	Amastra Knudseni Baldwin	(65,725)
"	45, 46.	Amastra breviata Baldwin	(65,723)

OBSERVATIONS ON THE DENTITION OF ACHATINELLIDÆ.

BY H. M. GWATKIN AND HENRY SUTER, WITH PREFATORY NOTE BY H. A. PILSBRY.

The dentition of the *Achatinellidæ* has already been investigated by Heynemann[1] and by W. G. Binney. The latter author, in co-operation with Thomas Bland,[2] has published several papers upon the subject, and to him is due the credit of discovering that within the group commonly known as *Achatinella*, two extremely different types of dentition exist.

The first, including *Achatinella s. str.*, *Partulina* and *Tornatellina* is characterized by an excessively delicate jaw (which is completely lost in potash preparations), and teeth arranged *en chevron*, in very oblique transverse rows, all of the peculiar form shown in Plate XI, fig. 52, and found also in *Athoracophorus*, etc. The shells of this group are glossy or brilliant, and the animal is arboreal.

The second type is seen in the groups *Amastra*, *Labiella*, *Newcombia*, *Laminella* and *Leptachatina*. Here the jaw is stronger, arched, and smooth or striate. The teeth are arranged in nearly straight transverse rows, and are of the type found in *Achatina* and *Rumina*, differing from the teeth of Helicidæ in the narrowness of the rhachidian row (see Pl. XI, fig. 56). The shell is dull in the majority of the species of this group, and the animal is in most cases terrestrial in habit.

Allied to the last in dentition, but distinct in its strongly ribbed jaw, is the genus *Carelia*, which thus constitutes a third primary group of Achatinellidæ.

These three groups are, there can be no reasonable doubt, of generic rank, and will bear the following names:

1. Genus ACHATINELLA Swainson, 1828. Contains the sectional divisions mentioned above, with some others. Of this generic term, *Helicter* of Pease and Fischer is a synonym. There is no reason-

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[1] Malak. Bl., 1869. *A. bulimoides*.

[2] Annals of the Lyceum of Nat. Hist of New York, X, p. 331, 1873; Ibid. XI p. 190; Annals of the N. Y. Acad. Sciences, III, pp. 98, 103.

able excuse for reviving Férussac's term *Helicteres*, for it was not intended as a generic or sub-generic name by Férussac, and is improper in form. Its use would open the door to an endless series of vagaries in nomenclature, as any one who examines Férussac's original publication may see.

2. Genus LEPTACHATINA Gould, 1848. Contains *Amastra*, *Newcombia*, etc.

3. Genus CARELIA H. and A. Ad., 1855.

The relationships of these genera and their subgenera will probably be decided by a study of their genitalia, which the writer hopes to undertake later; and these data will also aid in deciding whether the Achatinellidæ constitute a separate family, or are merely a division of Achatinidæ.

The following notes materially increase the list of species of which the dentition is known, and tend to strengthen the views advanced by Binney in the publications noticed above.

THE DENTITION OF THE ACHATINELLÆ. By H. M. GWATKIN.

Molluscous radulæ are in general fairly uniform in the species of a genus, and form a very trustworthy character. The chief anomalies are in a few families like the Buccinidæ, where the individual variation is greater than the specific, and in a few species where radulæ of two or more types are found, like *Phasianella* and *Calliostoma* among the marine genera, *Bulimulus* and *Cylindrella* among the terrestrial.

Achatinella is a conspicuous instance of the latter class. We find

All these are practically indistinguishable, except that those marked with an asterisk seem to have a central tooth.

(b). Jaw arcuate, strong, not ribbed. Radula oblong, not wide. Teeth quadrate, in nearly straight rows. Centrals small, narrow, sometimes faintly tricuspid; laterals larger, bicuspid; marginals bicuspid or multicuspid as in *Helix*.

To this section belong:

Achatinella assimilis Newc., *27.1.27 x 98=5,390*
A. helvina Bald. *32.1.32 x 108=7,020*
A. labiata Newc.
A. Mastersi Newc.
A. nana Bald.
A. pullata Bald. *28.1.28 x 99—5,643*
A. similaris Hartm.
A. umbrosa Bald.

Here again, though there are small differences in the number of teeth, the varieties of shape are very trifling. The central tooth of *A. helvina* is a little wider than usual, and the marginals of *A. umbrosa* take a peculiar form; but neither of these variations seems important.

ON THE DENTITION OF SOME NEW SPECIES OF HELICTER. By HENRY SUTER.

Some time ago Mr. D. D. Baldwin kindly sent me the animals of some species of *Helicter* for examination of their dentition, and I herewith give a short report.

Helicter (Apex) Cookei Baldwin.

Helicter (Bulimella) Lyonsiana Baldwin.

Helicter (Partulina) Dolei Baldwin.

These three species perfectly agree in the peculiarity of their dentition. There is no jaw, only a chitinous, transparent membrane Pl. XI, fig. 55, a, covering the lips. The radula, Pl. XI, fig. 55, b, forms a tube, compressed sidewise, with numerous folds; part of it is bent backward anteriorly, forming a collar. The teeth of the radula Pl. XI, fig. 52, x 1 x, form oblique rows at an angle of about 80°. The rhachidian tooth is long and slender, with a small reflection and two minute cutting points in *H. Lyonsiana*, no reflection could be seen in the two other species. The laterals and marginals are all alike, the denticles varying in number from five to six, in the last marginals from four to two; these teeth very much resemble the marginals of *Succinea*. The dentition is the same in all the three species, though they belong to different sections of *Helicter*, all of which are arboreal.

Helicter (Amastra) rubicunda Baldwin.

Helicter (Amastra), n. sp.

These two species, belonging to the same section, differ very much in dentition from the foregoing species. The jaw, Pl. XI, fig. 54, is solid, dark brown, horse-shoe-shaped, and beautifully finely striated vertically. The radula is tongue-shaped, the teeth arranged in almost straight transverse rows, and they are very much the same in both species, varying only in their number. Thus *Amastra rubicunda* has the formula 18.10.1.10.18 and *Amastra* n. sp. 22.12.1.12.22. It is hardly necessary to give a description of the radulæ, fig. 56, showing the most characteristic teeth of *A. rubicunda*. It may, however, be mentioned that the rhachidian and the laterals resemble somewhat those of *Achatina*, but the marginals are pectinate. The species of *Amastra* are not arboreal, but live on the earth.

Christchurch, New Zealand, August 8, 1894.

NOTES ON THE VARYING HARES OF WASHINGTON AND BRITISH COLUMBIA WITH DESCRIPTION OF A NEW SUB-SPECIES.

BY SAMUEL N. RHOADS.

In the determination of the relationships of the Varying Hare, *Lepus americanus*, of interior British Columbia it became necessary to handle a larger number of specimens of this group from west of the Rocky Mountains than has hitherto been available for study. This material includes typical specimens of *L. washingtoni* from near Puget Sound, four winter skins and ten skulls from near the Snoqualmie Pass, Washington, and four skins and six skulls from Hope, B. C., kindly loaned me by Mr. Outram Bangs. It is to be regretted that summer specimens of the Cascade Mountain form from Washington were not available as it is impossible to establish their relations to typical *washingtoni* in any other way. On this account these notes may be considered as merely preliminary to a more thorough investigation of material now being collected in these regions.

A comparison of a large series of skulls from the Cascades and lowlands of Washington convinces me that *washingtoni* is specifically distinct from *americanus* and it is probable that the form of *washingtoni* found in the higher Cascades is a well-marked race. The cranial characters, taken from average adult skulls from Maine and Puget Sound, which separate *americanus* and *washingtoni*, may be thus stated.

L. americanus	*L. washingtoni*
Postorbital processes wide, and flaring their internal posterior margins curved outwardly, their points directed outwardly and widely separated from frontal bones. Supraorbital processes of frontals strongly developed into a spur directed outwardly forward and forming, with the post-orbital process—an anvil-shaped promontory on each side the frontals.	Postorbital processes slender, the posterior margins straight or incurved, their points directed within the lateral sutures of the frontals, and in older specimens nearly touching them. Supraorbital margins of frontals serrate, sometimes with a single rounded notch.
Incisive foramina, together forming a regular isosceles triangle the double crenate base being	Incisive foramina jointly forming a hastate figure with rounded apex and basally narrower than at its median diameter. Greatest triturating width of molars 4.2 mm; basilar length of skull

L. americanus.	*L. washingtoni.*
the widest part of their expansion, and the apex acutely pointed. Greatest triturating width of molars 5 mm; basilar length of skull 58; zygomatic width 37; greatest outer distance between alveolar walls of right and left maxillaries 24.5.	56; zygomatic width 37; great distance between outer alveoli right and left maxillaries 20.7.

It will be seen that the molar and incisor dentition of *washingtoni* is relatively much weaker than in skulls of *americanus* of the same size, with a corresponding narrowing of the palatal and rostral area and a corresponding change in the shape of the incisive foramina, the constancy of which, coupled with the peculiarity of the frontal process, is to my mind quite sufficient for a specific separation of the Pacific and Atlantic coast representatives of this group.

The following diagnosis is of a hare whose cranial characters are distinctly the same as those of skulls of *americanus* from Maine:

Lepus americanus columbiensis sub sp. nov. Type, ad ♀, No. 462, Col. of S. N. Rhoads, Vernon, B. Columbia. Col. by S. N. Rhoads, July 29, 1892

Description. Size of average *L. americanus*. Summer pelage, above, light tawny gray, blackish on rump, tail and anterior border terminal of ears; anterior base of ears, crown, cheeks, upper fore leg sides of hams and upper surfaces of feet light rusty, soles of feet sooty. Inner fore and hind legs, lower head, lips, breast, fore part of abdomen and spot in forehead, white. Lower neck like back.

ations of *americanus* east of the Rocky Mountains by its grayness and almost total lack of rufous above. From the Rocky Mountain and east Cascade form which, for present purposes, may be called *airdi*, the color of the feet is a distinguishing character, while, as compared with *washingtoni*, the differences in color and size are obvious enough to need no comment.

DISTRIBUTION OF THE AMERICAN BISON IN PENNSYLVANIA, WITH REMARKS ON A NEW FOSSIL SPECIES.

BY SAMUEL N. RHOADS.

Pennsylvania enjoys the distinction of being the scene of the most easterly range of the buffalo, *Bison bison*, in North America. Dr. J. A. Allen, whose excellent memoir on the American Bisons furnishes the best data on this subject, has conclusively proved its existence up to the beginning of this century as far east as Buffalo Valley, near Lewisburg, in Union County. The last buffalo killed in that region was shot by Col. John Kelly, "about 1790 or 1800," on the McClister farm adjoining his own, and situate in Kelly township, about five miles from Lewisburg. Col. Kelly stated that an old Indian named Logan informed him of the former abundance of buffaloes in this valley. In the map of its distribution, Dr. Allen practically limits the range of the buffalo in the Keystone State to the country drained by the Allegheny and Monongahela rivers, which includes the region west of the Allegheny ridge on the south, and on the north, from a point in Clearfield county to the eastern shore of Lake Erie, westward. The movement east of this area is supposed to have been limited to the mountain passes extending second upper molar of a bison found at Pittston, Luzerne Co., Pennsylvania, in association with the remains of the mastodon and fossil horse. This he identified as belonging to the extinct *Bison latifrons*. Dr. Allen[1] contends that this tooth not only lacks the accessory column characteristic of the genus *Bison* but "it is in any case too small for a tooth of *Bison latifrons*," and thinks it "undoubtedly referable to the extinct musk-ox." Having examined the specimen in question and compared it with corresponding teeth of *Bison-bison* and the types of extinct muskox in the museum of the Academy of Natural Sciences of Philadelphia I find that this Pittston specimen is very much worn, the triturating surface having reached to the alveolar base of the enamel on the anterior and posterior sides. The roots of the tooth are intact, and comparison with a corresponding molar removed from the jaw of an adult *Bison bison* from Utah shows that the Pittston specimen is not materially larger than the one from Utah. Owing to the wearing of these molar teeth their triturating surface changes from an oblong, twice as long as wide, to a nearly square figure of nearly twice the triturating area seen in the teeth of a younger adult animal of same size. Dr. Leidy's oversight of this fact was probably the reason for his identification of the tooth as that of *Bison latifrons*, to which species, it may be remarked, he had referred larger specimens of the smaller *B. antiquus*.

In this respect Dr. Allen's position is sound; the tooth is too small to belong to *latifrons*.

On the other hand it is impossible that the tooth belongs to the extinct musk-ox, the corresponding molar in that animal being nearly twice as large in the type specimens preserved in the Museum of the Academy. The accessory cusp of the molars of *Ovibos cavifrons* is even more prominent than in *Bison*, so that the lack of this cusp in the Pittston specimen as effectually removes it from one genus as from the other, and I am inclined to consider the oval median islet in the specimen as representing an abnormal displacement of the accessory cusp of the genus *Bison*. If this is granted the other characters indicate it to belong to *Bison bison*.

Of interest in this connection are the first and third lower molars of an adult bison, evidently from the same individual, which were found in the collection of the Academy. These are mounted together on a card with the name "*Bison Americanus* DeKay, Luzerne Co., Pa." Accompanying them is a small card in Dr. Leidy's writing, which reads: "With the fossil teeth from Luzerne Co., but apparently more recent. *Bison Americanus.*" I have compared these with specimens of the recent animal and find them to be specifically identical.

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[1] The American Bisons, p. 12.

Waiving the question of the real status of the tooth figured by Leidy from this locality, we may safely rest the eastward extension of the habitat of *Bison bison* from Lewisburg sixty miles along the north branch of the Susquehanna on the two lower molars.

In the report of the Pennsylvania Geological Survey for 1887, Dr. Leidy, in a paper on limestone cave fossils of the State, makes the following statement in relation to certain bones found in Hartman's cave, Monroe County:—"With the remains of existing animals are those of a few species which no longer live in Pennsylvania * * * represented by a few jaw fragments and teeth of the woodland reindeer, *Rangifer caribou*, and a lower jaw fragment with the last molar tooth of the bison, *B. Americanus.*" This jaw fragment and its accompanying tooth are in the collection of the Academy. They belonged to a full grown animal in its early prime. The crown of the tooth has apparently been charred and crumbled by fire in the same manner as other bones from this cave which surrounded and lay within the site of an ancient fire place in the superficial layers of the cave floor. The mandible, which is about four inches long and two inches wide and contains the alveoli of the three true portion is five inches long superiorly and presents an unbroken upper surface three inches wide at base. The greater portion of the posterior surface at the base is also intact but the anterior and inferior surfaces have been destroyed.

The greatest vertical diameter of the core may be approximated at three and one-half inches, the horizontal being slightly less. From the disposition of the deep longitudinal grooves on its uninjured surface this core was probably eight or ten inches long.

These measurements indicate an animal much larger than the largest existing bison in America and approximate the size of the smaller extinct bison, *Bison antiquus* of Leidy and Allen. A remarkable character of the Durham cave specimen is found in its curvature and the relative position to the frontal plate. The superior longitudinal profile of the core is regularly convex throughout, forming the arc of a circle whose radius is about twelve inches; the posterior profile viewed from above is slightly concave, the anterior is broken, but the direction of the grooves show it to have been convex. The superior frontal arch viewed from behind is slightly depressed from the base of core towards the median line of the skull, but at a distance of one and one-half inches it rises to a point which would touch the continued arc of the superior profile of the core. The superior base surface of the core is very flat, describing in a breadth of three inches when viewed along a line at right angles to the skull, a regular arc whose radius is six inches. The line of division between the base of core and frontal bone lacks in a remarkable degree the osseous rugosity and prominence seen in the other members of this genus. If this core belongs to the left side of the skull, it very closely resembles the style of horn seen in *Bubalus buffelus* (Blum.) in which the drop of the horn is uniformly downward and backward from base to apex, the skull and horn cores forming, when viewed from behind, a regular, obtusely parabolic arch. Should it prove, however, that the specimen belongs to the right side, the drop is a forward one. There is a suggestion of the genus *Ovibos* in the flatness and downward growth of this horn, but a comparison of it with *O. moschatus*, *O. cavifrons*, and *O. bombifrons* shows a radical difference. From *moschatus* it is at once distinguishable by its narrowness and smoothness at base of core, by its greater convexity and by the width of intercorneal diameter of frontal bones; from *cavifrons* by the lack of any marked depression of the intercorneal plate; from *bombifrons* by its much greater size and by the flatness of horn core at superior base, which, in *bombifrons*, is highly arched as in *Bison bison*. The horn is also less abruptly depressed than in *bombifrons*, in this character being intermediate between the lop horned type of *Ovibos* and the erect type of bison, *B. patifrons* being in turn an intermediate type between the Durham cave specimen and *B. antiquus* which forms the last step toward the now existing *B. bison*, the apical portion of whose horn cores is vertical when the skull is poised at the normal facial angle of forty-five degrees. The striking peculiarities of this fossil appear to me sufficient to warrant a new specific name. I would propose BISON APPALACHICOLUS sp. nov., Type, No. 29, Col. Acad. Nat. Sciences, Phila., Durham Cave, near Riegelsvslle, Bucks Co., Pa. Postpliocene.

Regarding the question of the existence of *B. bison* in the valleys of eastern Pennsylvania since the advent of the white man in America, it is probable that it had been effectually driven from the Delaware Valley long before that date.

Indeed, from the scarcity of its remains and the absence of reliable tradition of its presence in this locality, it is unlikely that this species was ever more than a straggler in the regions east of the Susquehanna River drainage. It is not unlikely that the Carlisle cave specimens will be found to belong to the same species, as originally identified by Prof. Baird.

May 7.

The President, General Isaac J. Wistar, in the Chair.

Thirty-one persons present.

May 14.

The President, General Isaac J. Wistar, in the Chair.

Thirty-five persons present.

The death of Eckley B. Coxe, a member, was announced.

Dr. Vickers Oberholtzer read a paper on the geology of the Island of Œland. (No abstract).

May 21.

The President, General Isaac J. Wistar, in the Chair.

Fifty-five persons present.

The death of Henry John Carter, of London, Eng., a correspondent, was announced.

The following papers were presented for publication:

"The Extinction of Species." By Charles Morris.

"Synopsis of the Stizini of Boreal America." By Wm. J. Fox.

"Protoptychus Hatcheri, a New Rodent from the Uinta Eocene." By Wm. B. Scott.

"The Jelly-like Secretion of the Fruit of Peltandra undulata." By Ida A. Keller.

May 28.

The President, General Isaac J. Wistar, in the Chair.

Thirty-one persons present.

A memoir of John Howard Redfield, by Thomas Meehan, was presented for publication.

Wm. J. Gillespie, M.D. and H. G. Griffith, M.D., were elected members.

The following were ordered to be printed:

THE PRIORITY OF THE NAMES CALLISTE, AGLAIA AND CALOSPIZA AND THEIR USE IN ORNITHOLOGY.

BY WITMER STONE.

Although the name *Calliste* has long been in general use for a large genus of South American tanagers, a careful examination into its history seems to show that it is untenable in this connection and that we must adopt in its stead the name *Calospiza* proposed by G. R. Gray in 1840.

The birds which constitute this genus were separated from the old genus *Tanagra* almost simultaneously by two authors, Boie proposing for them the name *Calliste* (Isis, 1826, p. 974) and Swainson the name *Aglaia* (Zool. Jour. iii, 1827, p. 347).

In 1840 G. R. Gray established another name for the same group: *Calospiza*, (List of Genera of Birds, p. 44) stating that both the previous names were preoccupied by *Callistus* Bonelli, 1813, in Coleoptera and *Aglaea* Loureiro, 1780, in Botany. Cabanis adopted Gray's name emending it into *Callospiza* but subsequent writers have continued to use *Calliste* though several of them have subdivided the genus and proposed several additional names for their groups which are generally considered as synonyms. However we may regard the reasons which influenced Gray in proposing the name *Calospiza* there is certainly no question but that there are other facts in the case which compel us to adopt his name.

Some time ago Mr. T. S. Palmer called my attention to the fact that the name *Callista* had been proposed by Poli in 1791, for a genus of mollusks and asked me to examine the reference in Poli's work to which he had not access.

With the assistance of Prof. H. A. Pilsbry, Conservator of the Conchological Section of the Academy, I have carefully studied the history of this name. It was based by Poli (Testacea utriusque Siciliæ, Vol. I, Introduction, p. 30) upon the animals of several species of *Venus*, *Mactra*, etc., and was subsequently restricted by Mörck who fixed *Venus chione* as the type. Subsequent conchologists have used the name in a variety of ways but according to the present rules of nomenclature it seems that it must be adopted for the genus now known as *Cytherea* and in any case it precludes the use of *Calliste* in ornithology.

As regards *Aglaia*, while its previous use in botany does not, according to our present canons of nomenclature, preclude its use in ornithology, I find, nevertheless, that it is equally as untenable as *Calliste*.

In 1804 Renier (Prospetto della Classe dei Vermi, p. 16) proposed *Aglaja* for a genus of mollusks now generally known as *Doridium*, but for which *Aglaia* must be revived as recently pointed out by Prof. Pilsbry.

In 1825 Escholtz proposed *Aglaia* for a genus of Siphonophora, and as these authors both antedate Swainson's publication, the name, of course, cannot be used in ornithology.

Subsequently *Aglaia* has been proposed in 1850, by Albers, for another genus of mollusks and in 1869, by Brady, for a genus of crustacea, in both of which connections it is obviously untenable.

In view of these facts ornithologists will, I think, be compelled to adopt Gray's name for the genus of tanagers, the synonymy of which will stand as follows:

CALOSPIZA G. R. Gray 1840.

List of Genera of Birds, p. 44, type *C. tricolor* (Gm.).

1826. *Calliste* Boie, Isis, p. 974 (nec *Callista* Poli, 1791).
1827. *Aglaia* Swain., Zool. Jour. iii, p. 347 (nec *Aglaja* Renier, 1804).
1850. *Callispiza* Caban., Mus. Hein., p. 26.
1850. *Gyrola* Reichenb., Av. Syst. Nat., lxxvii.
1851. *Tatao* Bonap., C. R., xxxii, p. 80.
1851. *Callospiza* Bonap., C. R., xxxii, p. 80.
1851. *Chrysothraupis* Bonap., Rev. Zool., p. 142.
1851. *Ixothraupis* Bonap., Rev. Zool., p. 143.
1851. *Chalcothraupis* Bonap., Rev. Zool., p. 144,
1851. *Euschemon* Scl., Contr. Ornith., p. 95.
1851. *Euprepiste* Scl., Contr. Ornith., 95.

THE EXTINCTION OF SPECIES.

BY CHARLES MORRIS.

The story of the disappearance of species of animals and plants during the geological period, and their replacement by new species, is much too obscure to attempt to solve except to a very partial extent. Since life began upon the earth the process of extinction has been seemingly incessant, and still continues so, Man being perhaps the most efficient of all the many agents that have taken part in this process. As a rule, the extinction of forms would appear to have been gradual, and the simultaneous sweeping out of great numbers of species, which is claimed occasionally to have taken place, is open to question, from our lack of knowledge of the length of time really involved. There are, however, two instances in which such an extinction of numerous species within a comparatively brief interval appears certainly to have taken place, and it is these which I propose particularly to consider. These are the apparently sudden disappearance of great numbers of giant reptilian forms at the close of the Cretaceous epoch, and their replacement in the early Tertiary by numerous large mammals; and the similar sudden disappearance of a considerable number of large mammals in the Post-pliocene or the early Recent period, including the mammoth, the American horse, the giant sloths, etc. Although no other than general causes can be adduced for extinction as a whole, it may be that some particular causes can be suggested in connection with these two special instances.

As an important preliminary to this investigation, some consideration of the general causes of the disappearance of species is desirable. In the first place it is improbable that many, if any, species have ceased to exist in consequence of the direct assaults of other animals, except in the case of Man's destructive agency. A species, whose individuals are numbered by millions and whose range is ordinarily very extended, is not easily to be disposed of. Animal hostility, even when unrelenting and effective, is never governed by a fixed purpose of destruction. Its aims are minor and individual; food, not destruction, being its purpose. The only animals which act largely together in the work of destruction are the ants, yet with all their intelligent combination for this purpose it is almost certain that no species of insect owes its extinction to ant aggression. Among existing animals there are certain carnivorous fishes whose destruction of other, helpless species is annually enormous, yet these depleted species far from disappearing, return each year in vast multitudes to their feeding grounds. So far as existing evidence goes, then, it seems probable that hostile aggression, while it may have occasionally been an indirect, has rarely been the direct cause of the extinction of species.

It is equally doubtful if extinction has been due, as a general rule, to lack of suitable food. This may have been the case with certain invertebrates adapted to very narrow food conditions, and with some highly specialized vertebrates, confined to a transitory condition of the food-supply. But ordinarily the food-supply, at least of vertebrates, is wide-spread and persistent, while most of the higher animals have some power of variation in this respect, and can adapt themselves to new kinds of food. It would seem most probable, on the whole, that extinction of species has been generally due to indirect rather than to direct influences. Species of animals and plants have rarely, if ever, disappeared through their destruction by other species as food, and rarely through a natural insufficiency of food. Most probably the usual causes of destruction have been adverse conditions of nature, and the competition of other species in the struggle for food.

Nature undoubtedly has been active in this work, her adverse influences being violent and wide-spread; storms, sudden and severe changes in temperature, long-continued floods, extensive droughts, and occasionally highly destructive volcanic or other convulsions. To such influences entire species may in some instances have succumbed, particularly where the adverse conditions were of long continuance, while other species may have been so greatly reduced in numbers and energy as to become incapable of sustaining themselves against the competition of more vigorous rivals. Among recent instances of this kind may be classed the destruction of large numbers of cattle and other domestic animals on the western plains in winters of great severity and deep snow-fall. This destruction takes place despite all the efforts of Man to prevent it, and would be much greater but for human aid. On the other hand it must be said that these animals have been removed from their native habitat, and that their special exposure to danger is a result of Man's interference with nature's adaptations.

Organic competition takes various forms. An indirect struggle between species is constantly going on. The food supply is in every case limited, and is the object of an increasing contest between the individuals of a species and separate species, in which the most vigorous individuals or the best adapted species are likely to win. In this contest size and strength of a species are rarely assurance of success. Size may be detrimental, as necessitating more food, while strength is of little avail where the contestants are not directly pitted against each other. The mastodon, for example, needing great quantities of herbage for its food supply, might, in cases of severe drought, succumb to the food competition of the rabbit, or some still more insignificant creature, which, spreading in vast numbers over the country, devoured the sparse herbage and left its huge competitor to starve. An army of locusts has more than once brought great numbers of men to the verge of starvation, despite Man's intelligent and combined resistance. The potato bug is capable of depriving a nation of its food, and a blighting fungus may destroy the crop upon which a whole people relies. It needs all Man's care and prevision to prevent insect foes from destroying his food supply. The lower mammalia have no modes of defence against such assaults and no power of providing granaries of food against times of need. Thus hosts of herbivora may have frequently perished in consequence of an insect assault upon their food; and numerous carnivora, thus deprived of their food, may have similarly perished. Yet on the other hand, the lower plant-eating mammalia are much less exposed than Man to this special danger, from the fact that few of them feed, like him, on fruits and seeds, their general food supply being the abundant grasses, and the leaves and twigs of trees, a supply which is much less likely to fail.

An adverse influence, of the nature of direct assault, and one which at times may have been enormously destructive, remains to be mentioned. This is the aggressive action of the minute organisms known as bacteria, of which the disease-producing species have at times proved the most dangerous of all the known enemies of Man. At present, however, the indications are that they are much less destructive to the lower animals than to Man, the difference being due to difference of life habits. Though bacteria and other disease-producing agents may at times in the past have attacked species of animals destructively, it is probable that they have played but a minor part in the extinction of species.

There is still another interesting natural condition to consider in our review of the general causes of the extinction of species. One tendency, which has particularly manifested itself in herbivorous animals, has frequently led directly to their destruction. This is the tendency to increase in size through the double influence of abundance of food and little waste of tissue through exertion. In the sluggish grass-eaters, dwelling on plains covered with rich herbage, or leaf and twig eaters in tropical forests, the nutritive agencies are in excess of those of waste, and these animals seem always to have tended to an increase in size, until those of least exertion and greatest powers of obtaining food became enormous in dimensions. An example of the same kind among the carnivora is the Greenland whale, which, while feeding on minute forms, obtains them in enormous quantities with little muscular exertion, and has in consequence become of extraordinary dimensions.

In the case of the herbivora this increase in size has exposed them to increasing danger of starvation in cases of great drought, and from the food competition of smaller but more numerous animals, and many species may have became extinct through this cause. It is probable that a struggle has long gone on between the two organic to these influences. Nature has been frequently credited with this destructive work, some world-wide convulsion being called in to do duty as an efficient agent. But this cataclysmic theory has been largely over-employed, and could hardly have confined its ravages to the larger reptiles, of sea and land alike, while leaving the smaller reptiles and the contemporary mammals unharmed.

In seeking to discover some adequate cause for so great a natural event, one destructive agency, not as yet mentioned, offers itself as a not improbable explanation. It is one neither of inorganic action, of food competition nor of direct assault. On the contrary it is a kind of indirect assault—an assault not on the animals themselves, but on their eggs and young. This destructive influence is one that is very prevalent in the animal world. It is efficient in keeping down the numbers of prolific forms at present, and may have had much to do with the extinction of species in the past. It is a danger to which the mammalia are exposed only in the case of their young, and in this case only to a minor degree, from their vigilant care of their young; but to which the fish, reptiles and birds are exposed in the case of their eggs as well. The evolution of instinct has taught birds to care for their eggs and young, and thus in great measure to escape this peril. In reptiles this instinct of carefulness is very little developed, and in fishes scarcely at all. Fish species, indeed, escape annihilation mainly through fecundity. Though myriads of their eggs and young are devoured, enough escape to ensure the continuance of the species. The reptiles are intermediate between the birds and the fishes in these particulars, less prolific than the latter, less careful than the former. Existing reptiles take little or no care of their young and rarely any special care of their eggs. The turtles conceal theirs very skilfully in the sand and leave them to chance and secrecy for safety; the young, when hatched, being very agile in their escape to the water. But eggs and young alike have their enemies. The former are often discovered and devoured; the latter have numerous foes in and out of the water. Only a mere fraction of the brood escapes to keep alive the species. The crocodile lays its eggs in the warm sand, or in a heap of mud or decaying vegetation, and pays no further attention to them. The alligator is more careful, keeping some measure of watch and ward over its eggs. The existing land reptiles—the snakes, lizards and land turtles—as a rule, pay but little attention to the fate of their eggs and young, and in many cases leave them largely to chance, their sole trust being in concealment.

The degree of care paid by existing reptiles to the fate of their eggs, small as it is, may have been the result of a long-continued struggle for existence. As the activity and ingenuity of their foes increased, so may have increased reptilian care and fecundity. Probably ages ago both less heed was given to the security of the eggs than now and the peril was less imminent. There has very likely been a campaign of education on both sides. Yet it may be that the continued existence of the modern reptilian families is in a measure due to some degree of care always exercised over their eggs. And it is possible that little care may have been taken by the giant Mesozoic reptiles, and that their extinction was largely due to this cause.

The views here expressed certainly lead us to a fuller comprehension of the situation in which the Cretaceous reptiles were placed. These creatures, large and small alike, were egg layers, and their eggs and young were exposed to the peculiar dangers above indicated. To what extent they took care of their eggs we cannot know, but to judge from the habits of existing reptiles their care was not great. We are aware that these huge creatures possessed very small brains, and must conceive that they possessed little or no intelligence, being governed in great measure by the instincts acquired during past ages of slow development. These instincts were gained at an early period in which the eggs were little exposed fecundity. In consequence their danger of extinction through the destruction of their eggs was correspondingly increased.

In review of what is above said, it may be remarked that in the early days of reptilian dominance, and of general lack of animal activity and intelligence, the reptilian lords of the earth were exposed to little danger of being devoured in the egg by hungry enemies, and needed little care for eggs and young; the result being that no very marked instinct of concealment or personal supervision became developed. But during the later Mesozoic period, an important change took place in the situation. Ages before the reptiles lost their dominance a new order of beings, the mammals, had come into existence. The ancestors of the mammalia—typified by the modern Ornithorhynchus—were themselves egg-layers. Marsupial mammals followed, and continued throughout most of the Mesozoic age. Insignificant in size, and probably as lacking in intelligence as their reptilian competitors, these creatures long contented themselves with gleaning after the great reptiles, with no evidence of ability to compete with them. Finally appeared the placental mammals, whose young were at birth able to take care of themselves. And, with the coming ot this animal type the prevailing stupidity began to yield to a mental condition a step nearer intelligence.

The reptiles had hitherto occupied the field, the mammals being helpless against them by any direct methods of assault, while the greater activity of the latter, and the consumption of the bulk of the food supply by the great reptiles, checked any disposition in the mammals to increase in size. It is not unlikely that the newcomers gained the victory at length by the indirect methods indicated, an assault upon the eggs, and perhaps the young, of their powerful rivals.

It is highly probable that the placental mammals, with slowly developing intelligence, adopted, from time to time, new methods of attack; while the reptiles, depending mainly upon previously acquired instincts, were very much slower in developing new methods of defence. The reptiles, therefore, eventually found themselves at a serious disadvantage in competition with their small, active, and more cunning opponents. Contemporaneous with the great reptiles were multitudes of prowling creatures, small and agile, whose growing mental powers gradually made them aware that reptilian eggs were full of savory nutriment, and in time taught them the simple arts of concealment of the sea monsters, and how to circumvent the watchfulness, if any existed, of the small-brained land giants. The reptilian stream of life, in short, may have been thus assailed with increasing pertinacity and intelligence at its source, the eggs devoured, the young perhaps destroyed, and the numbers of these lords of land and sea rapidly reduced. As Achilles had his only vulnerable spot in the heel, these giant reptiles had theirs in the nest. The egg-destroying mammals had a double advantage. Laying no eggs themselves, and caring for their young, they could only be destroyed when in the mature stage, while their assault upon their foes was by the safer and more effective process of devouring them in the egg—a method which may well have caused rapid reduction in numbers and final extinction. The reptilian forms which continued to exist were likely to be the smaller and more prolific ones, and perhaps those which had developed somewhat efficacious methods of caring for their eggs—methods which may have continued to improve as the mental acuteness of their foes increased.

The ground once cleared by the disappearance of the larger reptiles, the subsequent rapid development of the mammalia is readily comprehensible. They now became the dominant class, and in all ages of geological history each new dominant class has expanded rapidly in numbers, in variety of species, and in life of individuals. They were no longer forced to glean after the harvest of powerful competitors, but had the earth's stores of food for their own, and developed accordingly, the remaining reptiles becoming in their turn the gleaners after the harvest. Not only the land, but perished from the cold. This seems probable from their high northern range, and the immense store of their remains now existing in northern Siberia, and in the ice-bound Liakhow or New Siberian Islands. A similiar fate may have overtaken the Irish elk, the urus, the mastodon, and other animals, but such was certainly not the case with the American horse, nor with the giant sloths and the glyptodon of South America, animals which became extinct during the same period.

The disappearance of the horse, in America, is an unsolved mystery. This animal extended in range through a double continent, and has left its remains from Alaska to Patagonia. The horse, it is true, is one of the most highly specialized of animals, and thus belongs to the class that is most liable to sudden extinction. But its specialization is not one that confines it within narrow or local limits or to a temporary phase of conditions. It is at home on the firm, grassy uplands, and is unsuited to forest, mountain, or moist lowlands. In the eastern hemisphere the natural habitat of the horse is on the steppes of Asia, while other species of the genus inhabit the plains of southern Asia and of Africa. In the western hemisphere it was probably most abundant on the open plains of central and western North America, and on the great grassy plains of the southern continent. As regards the habitat of the North American horse, it is one that is exposed to snows, frequently severe ones, in the winter season. The same may have been the case in Asia, if the habit of scraping with the fore-feet, which is possessed by the horse, arose, as has been supposed, from an instinct of scraping away the snows to get at the herbage beneath. Despite this instinct, in abnormal winters, many horses must have perished through the depth and persistance of the snows, as many cattle and sheep do now. During the glacial period this condition existed in an exaggerated degree, and may have caused the extinction of the North American horse. Most of its original range was buried under mountains of ice, which persisted for many centuries. South of the ice limit very frigid conditions must have existed, and deep and persistant snows each winter probably covered all the southern regions of the United States and the plateau of Mexico.

Under such conditions the horse might well have become extinct. Many contemporaries, such as the bison, the antelope, etc., could have taken refuge in the forest and swampy regions of the semitropical lowlands; but these were not suitable habitats for the horse, which could only thrive on the firm and grassy uplands, and which may in consequence have become extinct at this time in North America.

This explanation, however, fails to account for the disappearance of the South American horse, or of its huge contemporaries, the megatherium, megalonyx, mylodon and glyptodon. The disappearance of the last named animals, in view of their sluggishness and stupidity, is not inexplicable, since it may have been due to a cause similiar to that we have adduced in the case of the cretaceous reptiles—the destruction of their young by more agile and cunning animals. To this it may be objected that in such a case they would probably have disappeared early, and never attained their wide distribution. But this by no means follows. Intelligent animals may rapidly develop new methods of attack. Unintelligent animals are not likely to develop new methods of defence with similar rapidity. If some active carnivorous animal, therefore, began to attack and destroy the young of the giant sloths in a new and covert manner, the parents may have proved quite incapable of guarding against this suddenly developed danger, and the coming generations of these creatures may have been fatally reduced.

We must, however, in considering the problem of the disappearance of the animals in question, take into account a hostile agency which did not exist at any earlier period—that of Man. A new lord of the earth had appeared, and one with powers of destruction never before possessed in the animal world. Within quite recent times several species of animals have become extinct through human aggression. Others may have become extinct in the past. We know that the early savages of Europe killed the horse and other large animals for food, and the early Americans may have done the same. Man may have played an active part in the extinction of the giant sloths and the glyptodon—if they persisted till the human period—by destroying their young, even if he did not attack the mature animals—and have thus cut off these specially dull and slothful species.

Such an explanation will not account for the extinction of the South American horse, nor does any hypothesis—even of an unsatisfactory character—suggest itself. It is true that some entertain the idea that the South American horse did not become extinct.

Not many years after the horse had been introduced into South America by the Spaniards, the crew of a vessel, sailing along the coast, saw a number of horses at a point several hundred miles distant from the small settlements to which horses had been brought from Europe. It is considered questionable that horses which may have escaped from these settlements could have increased in a few years sufficiently to extend several hundred miles away. That the horses thus seen were native animals is possible, though very doubtful, since it seems probable that the native American horse, though of the same species with the European, may have presented some varietal differences in appearance. All that we can say is that this incident leaves the question of the extinction of the South American horse open to some, though a very slight, degree of doubt. If, as is probable, it became extinct, the cause of its extinction must remain an unsolved mystery. In short, the whole subject of animal extinction is one that is rife with difficulties. The best that can be done is to offer some suggestion of causes that may have aided in the disappearance of species: It is quite probable, however, that many influences were at work of which we are ignorant, and most of which will always remain beyond the scope of human investigation or conjecture.

SYNOPSIS OF THE STIZINI OF BOREAL AMERICA.

BY WILLIAM J. FOX.

In working over the fossorial wasps belonging to the genera included in Handlirsch's monograph[1] it seemed to me that, inasmuch as the latter's work is probably inaccessible to most American entomologists, the publication of synoptical tables of those genera elsewhere, together with such notes as may be available, and the description of new species should there be any, would be of service to those interested in the subject. It is my hope to work gradually over the genera monographed by the above author, and to prepare from time to time synoptical tables for publication. Therefore, this paper may be considered the first of a series, which I trust will be concluded in the near future.

The two genera composing the Stizini may be separated as follows:

Marginal cell about twice as long as the first submarginal; spurs of hind tibiæ enlarged in ♀ and the pygidium well developed; abdomen (♂) with a single spine at apex. SPHECIUS.

Marginal cell much shorter than the first submarginal; spurs of hind tibiæ short in both sexes, not enlarged; no well-developed pygidium, at the most with a short ridge on each side of the last dorsal abdominal segment; abdomen (♂) with three spines at apex. STIZUS.

SPHECIUS Dhlb.

Sphex Drury (in pt.) Ins. II, Pl. 38, fig. 1, p. 71, 1773.
Stizus Latreille, Tab. Encycl. et Method, pl. 382, fig. 6. 1809.
Sphecius Dahlbohm, Hym. Eur., p. 154, 1845.
Hogardia Lepeletier de St. Fargeau, Hym. III, p. 288, 1845.
Stizus, various authors. For full synonymy see Handlirsch, Sitzb. Akad. Wissensch. Wien. XCVIII, Bd., Abth. 1, p. 441.

FEMALES.

Abdomen with segments 1–3 only of abdomen spotted with yellow.
  Black, legs rufous; punctuation of second dorsal abdominal segment rather close . . . . *speciosus.*
  Entirely rufous, excepting of course the abdominal and face markings; punctuation of second dorsal abdominal segment very sparse . . . . *convallis.*

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[1] Sitzungsberichte der K. Akademie der Wissenschaften. Mathematisch-naturwissenschaftliche Classe. XXXV—LI.

Abdomen with segments 1–6 spotted with yellow. Color varying from black to rufous, with intermediate forms . . . . . . *grandis.*
Abdomen red and black, not spotted . . . . *Hogardii.*

MALES.

Joints of flagellum not strongly rounded out beneath.
  Black, legs rufous . . . . *speciosus.*
  Rufous in greater part.
    Abdomen rufous, the first three segments maculated with yellow . . . . *convallis.*
    Abdomen rufous and black . . . . *Hogardii.*
Joints of flagellum strongly rounded out beneath; abdominal markings not confined to the first three segments, all the dorsal segments being maculated. Color varying from black to rufous. . . . . *grandis.*

1. Sphecius speciosus Dr.

Sphex speciosus Drury, l. c.
Vespa tricincta Fabricius, Syst. Ent., p. 363.
Stizus vespiformis Latreille, l. c.
Stizus speciosus Lepeletier de St. Fargeau et Serville, Encycl. Method. pl. 382, fig. 6.
Hogardia speciosa Lepeletier de St. Fargeau, l. c.
Sphecius speciosus Dahlbohm, l. c.
Stizus speciosus Packard, Proc. Ent. Soc., Phila., VI, p. 442.

Common in the Eastern United States; Texas; Mexico (Handlirsch).

2. Sphecius convallis Patt.

Stizus grandis Packard (non Say) l. c., p. 442.
Sphecius speciosus var. *convallis* Patton, Bull. U. S. Geol. Survey, p. 343, 1879, ♂ ♀.
Sphecius raptor Handlirsch, l. c., p. 461. ♂ ♀.
Sphecius convallis Fox, Proc. Calif. Acad. Sci., [2] IV, p. 103.

Kansas; Texas; California; Lower California. The second abdominal segment in ♂ is not sparsely punctured like the ♀, but is about the same as in the ♂ of *speciosus*.

3. Sphecius Hogardii Latr.

Stizus Hogardii Latreille, Genera Crust et Ins., IV, p. 100, Plate XIII, f. 12, ♀.
Hogardia rufescens Lepeletier de St. Fargeau, Hym. III, p. 289.
Stizus Hogardii Smith, Cat. Hym. Brit. Mus., IV, p. 336, Plate VIII, f. 4.

This is a West Indian species, but has been recorded from Key West and the Bahamas, and must therefore be added to our lists.

4. Sphecius grandis Say.

Stizus grandis Say, West. Quart. Rep. II, p. 77.
Stizus fervidus Cresson, Tr. Amer. Ent. Soc. IV, p. 223, ♀
Stizus nevadensis Cresson, ibid, V, p. 99, ♂

Tennessee (Handlirsch); Arkansas (Say); Missouri (Riley); Texas; New Mexico (Cockerell); Utah; Nevada; Washington. Handlirsch considers *grandis* and *fervidus* as distinct species, but the distinguishing characters given by him, (the coloration and sculpture of thorax above) are shown to be variable by a series of twenty-three examples before me, and the color of the wings is not constant.

STIZUS Latr.

Stizus Latreille, Histoire naturelle, III, 344, 1802.
Bicyrtes Lepeletier de St. Fargeau, Hym., III, p. 53, 1845.
Bembecinus Costa, Fauna del Regno di Napoli, 4, 1859.
Larra Smith (non Fabr.) Cat. Hym. B. M., IV, p. 337.
Megastizus Patton, Bull. U. S. Geol. Survey, V, p. 334, 1879.

FEMALES.

Middle segment emarginate posteriorly at the sides; females . 2
Middle segment not emarginate, the postero-lateral angles rounded 4
2—Second submarginal cell distinctly petiolate 3
Second submarginal cell not petiolate, but the first and second transverso-cubital nervures touch at the marginal cell; space between hind ocelli slightly greater than that between them and nearest eye margin; antennæ placed at a distinctly greater distance from the clypeus than from the eyes; black, with yellow maculations, the greater part of coxæ, trochanters, tibiæ and the tarsi entirely, yellow; legs robust . . . . . . *neglectus*.
3—Antennæ placed at about the same distance from clypeus as from the eyes; space between hind ocelli just about equal to that between them and nearest eye margin; not densely hirsute; tibiæ only in part yellow; hind tarsi entirely black . . . *Godmani*.
Antennæ placed somewhat farther away from the clypeus than

Yellowish spots on dorsal abdominal segments 3 and 4 distinctly separated internally; clypeus about as broad as the three first joints of antennæ united are long, its anterior margin not strongly incurved, subtruncate; lateral ridges of pygidial area short, not twice as long as the latter is broad at apex . *texanus*.

MALES.

1—Middle segment emarginate posteriorly at the sides; twelfth antennal joint spinose beneath 2

Middle segment not emarginate, the postero-lateral angles rounded; twelfth antennal joint not spinose 5

2—Black, with paler markings 3

Yellow, with black markings 4

3—Seventh ventral segment slightly carinated down the middle; space between eyes at base of clypeus distinctly less than the combined length of joints 1 and 2 of flagellum; spine at apex of eleventh antennal joint straight, rather short and indistinct; tibiæ in part black . . . . *Godmani*.

Seventh ventral segment flat, not carinated; space between the eyes at base of clypeus about equal, or nearly so, to the combined length of joints 1 and 2 of the flagellum; spine at apex of eleventh antennal joint curved, long and prominent; tibiæ entirely yellow . . . . *nanus*.

4—Second submarginal cell distinctly petiolate . . . . *flavus*.

Second submarginal cell not petiolate . . . . *xanthochrous*.

5—First and second transverso-cubital nervures widely separated above. Size large 6

First and second transverso-cubital nervures narrowly separated above or melting. Size medium; entirely deep black, the second dorsal abdominal segment with a reddish fascia; wings blue-black, the apical margin whitish . . . . *unicinctus*.

6—Yellowish spots on dorsal abdominal segments 3 and 4 extended, so that they nearly meet internally; last dorsal segment rounded at apex . . . . *brevipennis*.

Yellowish spots on dorsal abdominal segments 3 and 4 widely separated internally; last dorsal segment with a small, but distinct emargination at apex . . . . *texanus*.

1. Stizus Godmani Cameron.

Stizus Godmani Cam., Biol. Centr. Amer., Hym., Pl. V, fig. 8, a. b. c., ♀ ♂.
Stizus agilis Cam. (non *S. agilis* Sm.), ibid., p. 102.

Mexico (Cameron); Lower California; Santa Fé and Las Cruces, New Mexico (Cockerell); Colorado.

2. Stizus nanus Hdl.

Stizus nanus Handlirsch, Sitzb. Akad. Wissensch., Wien , LI, Bd., Abth., I, p. 61. ♂ ♀.

Georgia.

3. Stizus flavus Cam.

Stizus flavus Cameron? l.c., p. 103, Pl. V, fig. 9, a. b. c., ♂.

Mexico (Cameron); Lower California; New Mexico (Cockerell); Colorado (Gillette).

4. Stizus servilli St. Farg.

Bicyrtes Servilli St. Fargeau. Hym., III, p. 53, 1845.
Stizus Servillii Handlirsch, l.c., p. 65.

Philadelphia (St. Fargeau). Unknown to me.

5. Stizus xanthochrous Hdl.

Stizus xanthochrous Handlirsch, l.c., p. 69, Pl. I, figs. 19, 10.

Texas: Cypress Mills (Coll. Ashmead). Resembles *flavus*, but the second submarginal cell is not petiolate.

6. Stizus moneduloides Sm.

Larra moneduloides Smith, Cat. Hym. B. M., IV, p. 436, ♂ ♀.
Bembecinus moneduloides Cresson, Synopsis, p. 278.
Stizus moneduloides Handlirsch, l.c., p. 69.

Florida (Smith); Mexico (Cameron). Unknown to me. Handlirsch regards his *nanus* as possibly identical with this species, but Smith's description is not sufficiently clear to decide it, as he does not say whether the second submarginal cell is petiolate, or not; according to Cameron who reports the species from Mexico, this cell is not petiolate, which fact would indicate that *nanus* is distinct from it.

7. Stizus neglectus Cress.

Monedula neglecta Cresson, Tr. Am. Ent. Soc., IV, p. 222, ♂.
Stizus neglectus Handlirsch, l.c., p. 70.

Comal Co., Texas.

PROTOPTYCHUS HATCHERI. A NEW RODENT FROM THE UINTA EOCENE.

BY W. B. SCOTT.

[Investigation aided by a grant from the Elizabeth Thompson Fund of the A. A. A. S.]

Mr. J. B. Hatcher, Curator of vertebrate palæontology in the Princeton Museum, who is at present (April, 1895) collecting in the Uinta beds, (upper Eocene) of Utah, has lately discovered a small rodent-skull of a previously unknown type, and recognizing its importance, has sent it in to me for examination and description. The skull proves to be of unusual interest and brings to light some very unexpected facts, which I hasten to bring to the attention of students of the rodents.

The Dentition.—Only the teeth of the upper jaw (fig. 3) are represented in the specimen, the mandible having been lost. The dental formula is: I1 C0 P1 M3. As the front end of the rostrum is broken away, only a transverse section of the incisors is visible in the specimen and here they are seen to be rather small and laterally compressed; there is nothing to indicate that these teeth were sulcate. The premolar, p4, is of only moderate size, not quite so large as m1. Owing to its somewhat abraded condition, the pattern of this tooth is rather difficult to make out and all that can be clearly seen is a narrow invagination of enamel from the external side, which extends across about half the transverse width of the crown, and on the inner side is an extremely shallow enamel indentation. The first molar a little exceeds in size any of the other cheek-teeth, though there is not much difference between any of the series in this respect. In its present condition of wear, this tooth displays a deep invagination of enamel from the outer side of the crown, and a very shallow one from the inner side, which, however, is distinctly better marked than in the premolar. The second molar is slightly smaller than the first, but of similiar conformation. The third molar, perhaps in consequence of the fact that it is less worn than the others, is of a somewhat different pattern. In addition to the enamel invagination from the inner and outer sides, it has two low transverse crests, with a shallow depression in front of the anterior one and behind the posterior one. These teeth are all very brachyodont, with transversely oval crowns, and form a slightly curved series with the convexity outward, so that those of the two sides converge at both ends and are most widely separated in the middle.

It is difficult to find among modern rodents any type of dentition which altogether corresponds to the one here described. The transverse crests visible on m3 of *Protoptychus* (and doubtless in the unworn state of the other teeth, also) have a certain resemblance to the teeth of the squirrels and spermophiles, but the fundamental character of the tooth-pattern is given by the enamel invaginations, which tend to divide it into two prisms. This arrangement is most like that found in *Pedetes*, the *Heteromyidæ* and *Geomyidæ*. The resemblance of the Uinta form to the John Day genera, *Entoptychus* and *Pleurolicus*, especially to the latter which is brachyodont, is decidedly marked.

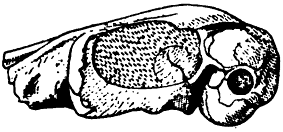

Fig. 1. *Protoptychus Hatcheri;* Skull from left side: natural size.

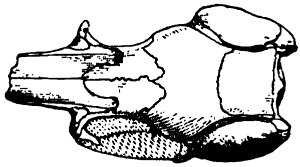

Fig. 2. *Protoptychus Hatcheri;* Skull from above; natural size.

of the different bones which compose it resemble more the arrangement which obtains in *Dipus*. The rostrum is also less tapering and acuminate than in the recent *Heteromyidæ*. The transverse width of the skull is greatest in the mastoid region, though these bones project but slightly beyond the line of the zygomatic arches and thus the width is nearly uniform from the front of the orbits to the occiput. In all of the existing *Dipodidæ* the skull is widest across the zygomatic arches. In *Protoptychus* the skull is long and narrow as compared with that of *Dipus*, though not far removed from the proportions of *Zapus*. The interorbital constriction is very slight, much as in *Heteromys*, and thus decidedly less than in *Zapus*. Aside from the inflated mastoids, the broadest part of the cranium is across the parietals and behind the orbits. The hinder part of the cranium displays very large, rounded and swollen mastoids, such as occur in the recent *Dipodidæ* and *Heteromyidæ*, though their shape and construction are more like what we find in the latter family than in the former. The mastoids encroach more upon the roof of the skull and the occipital plane than in *Perognathus* or *Cricetodipus*, and quite as much as in *Dipus*, though in a somewhat different way and with a different effect upon the surrounding cranial bones from the latter.

In spite of the great size which the mastoids have already attained, small, but distinct temporal fossæ are preserved, such as persist in *Heteromys*, but in no other member of that family. More of the squamosal is retained on the walls of the cranium in the existing *Dipodidæ* than in *Protoptychus*, but not such distinctly marked temporal fossæ. The consistency of the bones of the skull, their ridges and angles are much as in *Dipus* and have not that excessively thin and papery appearance which characterizes *Zapus* and the recent *Heteromyidæ*. There is no indication of a sagittal crest. Viewed in profile, the highest point of the skull is behind the orbits, at the slightly swollen and gently convex parietals, as is also true of *Zapus* and *Perognathus*; from this point the upper contour descends gradually in front to the rostrum and behind to the occiput, though the curvature of this surface is but slight. The inferior surface of the cranium is rendered different in appearance from that of any of the *Heteromyidæ* by the larger size and more spherical form of the tympanic bullæ, which have much the same shape as in *Dipus*, but the bullæ are not separated from the neighboring cranial bones by such fissures as occur in the latter and in *Pedetes*, as well as in *Dipodomys*, conforming more in this respect to the condition of *Zapus*. The large incisive foramina constitute another point of resemblance to *Dipus*.

Taking up the structure of the skull more in detail, we find that the rostrum is narrow, decidely more so than the interorbital space, and quite deep vertically, its diameter in this dimension exceeding the transverse. The nasals are considerably broader than in *Heteromys* or *Perognathus* and have more the relative width found in *Dipus*, but they extend much farther back than in any living genus of either family, reaching along their external borders to the middle of the orbits, slightly behind the termination of the ascending processes of the premaxillaries. In the *Dipodidæ* the nasals cease in front of the orbits and they extend but little more backward in the *Heteromyidæ*. The hinder ends of the nasals are deeply emarginated to receive the long nasal processes of the frontals, which are far more conspicuous than in either of the modern families named. Posteriorly the nasals are slightly concave transversely; farther forward they become strongly convex in the same direction and together form a semicylinder. This anterior convexity is more pronounced than in *Dipus* and it may indicate a tubular prolongation of the rostrum in front of the incisors, such as occurs in the *Heteromyidæ*. The nasals are accompanied for nearly their entire length by ascending processes of the premaxillaries, which articulate suturally with the frontals. On the top of the skull these processes are, as in the latter, a distinct ridge or angulation running along their external margins, which form small temporal fossæ, more distinctly marked than in any other member of the family. In *Dipus* and *Pedetes* the parietals are very short and wide, while in *Zapus* they retain much the same proportions as occur in *Protoptychus*, though they have not the external angulation, nor the concave temporal fossæ found in the latter. In the fossil the parietals are slightly swollen and gently convex in both directions, with a shallow depression in the median line.

The interparietal is very large and of a somewhat different shape from that of any of the recent genera of the two families. In the *Heteromyinæ* this bone is very wide and of varying shapes in the different genera. Thus, it is elliptical in *Perognathus*, pentagonal in *Cricetodipus*, and in *Heteromys* broadly cordate. In the *Dipodomyinæ* this bone has become very small and is longer than wide, a condition due to the great encroachments made upon the cranial walls by the enormously inflated mastoids. *Dipus* has a broad shield-shaped interparietal, *Pedetes* one which is very short and wide and of peculiar shape, while in *Zapus* it is a wide ellipse. The interparietal of *Protoptychus* differs from that of all the genera named, being very large and of nearly square outline, though the breadth slightly exceeds the length; the latter diameter is, however, much greater relatively than in any of the recent genera, while the narrowing is obviously due to the expansion of the mastoids. The external ridges of the parietals are continued over upon the borders of the interparietal, which otherwise is nearly plane, but is thus made slightly concave.

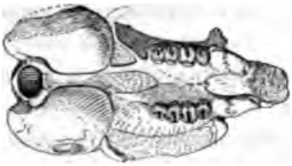

Fig. 3. *Protoptychus Hatcheri*; Skull from below; natural size.

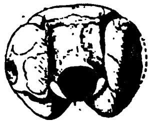

Fig. 4. *Protoptychus Hatcheri*; Skull, occipital surface; natural size.

The occipital surface is almost flat, except for the protuberances formed by the mastoids, and is considerably higher than wide, the inflated mastoid bullæ having greatly narrowed it. In general appearance the occiput is quite like that of *Pleurolicus diplophysus* of the John Day, (see Cope, Tertiary Vertebrata, Pl. LXIV, fig. 9^c), but in the latter the mastoids are not so much enlarged and the occiput is, consequently, wider than high. The supraoccipital of *Protoptychus* most resembles that of the *Heteromyidæ;* it appears on the top of the skull only as a very narrow strip and, so far as can be judged from the specimen, it does not send out spurs which embrace the interparietal between them, such as are found in *Perognathus* and *Cricetodipus.* On the plane of the occiput the supraoccipital occupies a little more space, but even here it is very narrow from above downward, nearly the whole of this surface being formed by the large exoccipitals. In *Dipus* the spurs which enclose the interparietal are very peculiarly shaped, for they are produced downward over the mastoid bullæ and articulate with narrow processes given off from the squamosals. In *Pedetes* there are no such spurs from the supraoccipital and so far there is a resemblance to the fossil, but the distinct angle made by the occipital plane with the top of the skull in the latter is heteromyine rather than dipodine in character. In the Uinta genus the foramen magnum is very large in proportion and of subcircular shape, while the occipital condyles are exceedingly small, widely separated from each other and so closely applied to the great bullæ, that it is difficult to see how they could conveniently articulate with the cotyles of the atlas. No distinct paroccipital processes are observable. Such processes are distinct in *Dipus* and still more so in *Pedetes,* but in *Zapus,* as in the *Heteromyidæ,* they are exceedingly minute. The basioccipital and basisphenoid are reduced to excessively narrow, slender rods, which are more attenuated than in any of the *Heteromyidæ,* not even excepting *Dipodomys.* In *Dipus* these two bones form together a wedge-shaped piece, which narrows rapidly forward; the basisphenoid is thus as slender as in *Protoptychus,* but the basioccipital is broader. Much the same statement will apply to *Perognathus.* This difference is due to the fact that in the fossil the largely inflated tympanic bullæ are of a different shape, and in particular, have a greater transverse diameter proportionately than have any of the modern forms mentioned.

The mastoids are very greatly inflated and form large portions of the auditory bullæ, which are the most conspicuous and striking features of the skull. The shape of these structures has resemblance both to the *Heteromyidæ* and the *Dipodidæ*. The relative size of the mastoids is about the same as in *Dipus* and *Pedetes*, but they have a less extension vertically and a greater one antero-posteriorly than in those genera. In *Zapus* the mastoids are but moderately inflated, and in *Heteromys* they are in much the same condition, so as not to form conspicuous parts of the cranial walls. In *Perognathus* these bones are much more swollen and conspicuous, but they form comparatively little of the top of the cranium, do not bulge out strongly from the sides of the skull and project but slightly behind the plane of the occiput. In this genus the mastoid articulates extensively with the parietal and helps to give it its characteristic pentagonal shape. In *Cricetodipus* the mastoids are still more swollen and project so decidedly backward that the proper occipital surface appears like an emargination. In the *Dipodomyinæ* the mastoids are inflated to a most extraordinary degree, reducing all the other cranial bones of that region to mere strips. In *Protoptychus* these bones are dilated much more than in either *Perognathus* or *Cricetodipus*, though not approximating the enormous size which they attain in *Dipodomys*, and form very conspicuous prominences, which project both laterally and posteriorly. They do not, however, articulate with the parietals, from which they appear to be separated by the narrow prolongations of the squamosals which form the temporal fossæ. The parieto-mastoid articulation occurs in the modern forms of both the *Dipodidæ* and the *Heteromyidæ*, even in those genera in which the mastoid is only moderately inflated. The construction of the mastoid bullæ in the fossil has most resemblance to that of the *Heteromyidæ*. In *Dipus* and *Pedetes* this structure is high vertically, not much elongated antero-posteriorly and not so divided into chambers that the division is clearly visible from the outer side. In the fossil, as in *Cricetodipus*, the mastoid bulla is laterally compressed and more extended antero-posteriorly than laterally; it is divided by partial septa into chambers, two of which are plainly shown, even externally, being bounded by deep grooves. Of these two chambers, the hinder one is short, high and narrow and lies behind the auditory meatus, while the anterior one is longer, lower and broader and lies above the auditory meatus, the two divisions meeting at nearly a right angle. In *Dipodomys* the arrangement is similiar, but the anterior chamber is much more strongly inflated and, in particular, is very much wider.

The tympanic portion of the auditory bulla is more swollen a of a different shape from that of any of the recent *Heteromyidæ* a more resembles that of *Dipus*. It is relatively very large and hemispherical form, with nearly equal transverse, antero-posteri and vertical diameters, and differs markedly from the elongat somewhat depressed and flask-like form characteristic of the pocke mice. The front ends of the two bullæ are quite near together, bu they have not the narrow prolongations, corresponding to the neck the flask, which are found not only in the pocket-mice, but also i the lower Miocene genus *Entoptychus*, which I regard as one of th forerunners of the *Geomyidæ*. The tympanics are in close apposition to the basi-occipital and basi-sphenoid, as in *Zapus* and *Perognathus*, not isolated by the fissures which occur in *Dipus* and *Dipodomys*. The opening of the auditory meatus is nearly circular and forms even less of a tube than in *Zapus* or *Perognathus*.

The crowding and displacement of the cranial bones which result from the great development of the mastoid bullæ has already in *Protoptychus* attained a remarkable degree, more advanced than in several of the existing genera. Compared with the skull of *Dipus*, in the fossil we find that the elements which lie in front of the mastoid are more reduced. This is due to the much greater relative size of the brain in the modern genus, which has broadened the frontals and parietals in a very striking way, and probably even the greater width of the basi-occipital is due to the same factor. The *Heteromyidæ* exhibit many differences among themselves in this respect, the from weathering, it may have been present originally. If so, it must have been exceedingly fine and thread-like, as it is in *Dipodomys.* There is no postorbital ridge or plate, such as is found in *Dipus*, though not in *Zapus*. The zygomatic process is longer and in every way better developed than in the *Heteromyidæ*, but it does not project out so far from the sides of the skull as in *Dipus* or *Pedetes*, but has about the same degree of proportionate development as in *Zapus*. It is separated by a considerable interval from the tympanic.

The jugal has been largely weathered away from the specimen, but the anterior portion remains, as well as the imprint of the entire bone on the matrix filling the orbit of the left side, which allows its shape and connections to be determined with a fair degree of accuracy. The horizontal portion is longer than in the recent genera of *Dipodidæ* or *Heteromyidæ*, and though very thin and compressed, forming a vertical plate, it is stouter than in any of the modern forms, except *Pedetes*. The ascending portion is decidedly broader and is continued up along the anterior edge of the orbit and forms a suture with the lachrymal, as in the recent jumping-mice. The form of this process is most like that of *Zapus*, among the existing genera; it is a wide plate, with recurved external border, convex externally and concave internally, somewhat as in *Zapus*, though owing to the smaller size of the infraorbital foramen, it is less attenuated. In *Dipus* the edge of the plate is not recurved, but projects directly outward and helps to give the extraordinary breadth which the face has at this point—the widest part of the skull. The anterior portion of the zygomatic arch is at a lower level than in the recent jumping-mice and here the arch is less horizontal; nor has it the decided downward curvature found in *Dipus;* in front the arch is not so widely separated from the alveolar portion of the maxillary as in the recent genera. The zygomatic process of the maxillary is much like that of *Zapus*. The infraorbital foramen is a large aperture perforating the zygomatic process; in shape it is high, narrow and somewhat pyriform, resembling that of the typical *Muridæ*, except that its position is reversed, being narrower above than below. There is no separate canal, or even notch, for the nerve, such as is found in the recent jumping-mice. The zygomatic process arises a little in advance of the premolar, as it does also in *Zapus;* in *Dipus* it is shifted somewhat farther forward, while in *Pedetes* it extends so far anteriorly that the ascending process of the jugal appears to rise out of the middle of the zygomatic arch. The zygomatic process of the maxillary is thus merely a slender frame-work enclosing the infra-orbital foramen and strengthened on the outer side by the ascending process of the jugal. This is quite different from the perforated plate of the true mice and still more from the imperforate plate of the *Heteromyidæ* and *Geomyidæ*. The lachrymal is a very small bone, which is placed at the antero-superior angle of the orbit and articulates with the frontal and the jugal.

The premaxillaries are large and quite heavy bones, very narrow, but of considerable vertical extent; their palatal surface is reduced to two narrow rods, one on each side of the very large incisive foramina. The maxillo-premaxillary suture is just in advance of the zygomatic process, as is also the case in *Dipus* and *Zapus*, and thus the sides of the rostrum are formed almost entirely by the premaxillæ. The incisive foramina are very large, though the apparent size is increased by the loss of the premaxillary spines; they deeply emarginate the palatal processes of the maxillaries and extend back as far as m1. The John Day genus *Paciculus* and several of the recent *Dipodidæ*, such as *Zapus*, *Dipus*, *Alactaga*, etc., have a similar conformation of the incisive foramina, but in the latter they do not cut so deeply into the maxillaries. This appears to be due to the growth of the part of the maxillaries in front of the premolar which accompanies the forward shifting of the zygomatic process. In *Pedetes*, in which this shifting has attained its maximum, the foramina have

The new genus and species may be defined as follows:

PROTOPTYCHUS.

Gen. nov. p $^{1}_{.}$, m $^{3}_{-}$, cheek-teeth brachyodont, in the worn condition with deep enamel invagination from outer side and shallow depression on inner side of crown. Infraorbital foramen large, pyriform, perforating zygomatic process of maxillary. Jugal articulating with lachrymal (?). Mastoids much inflated, in degree intermediate between those of *Cricetodipus* and *Dipodomys*; tympanics much inflated and hemispherical. Interparietal nearly square. Incisive foramina very large.

P. Hatcheri n. sp.

Length of skull about as in *Perodipus Ordi*. Internal enamel invagination of p ^{4} much less marked than in ^{m} grinding teeth of nearly equal size, m $_{-}^{1}$ slightly larger than the others. Nasals wide. Occiput higher than wide.

This species is dedicated to its discoverer, Mr. J. B. Hatcher, whose long and arduous labors in behalf of palæontology have been crowned with such brilliant success.

Measurements.

	M.M.		M.M.
Length of skull from inion to zyg. proc. of max.	0.027	Height of rostrum at base	.009
Breadth of skull at mastoids	.020	Interparietal, length	.007
Breadth of skull across zygomatic arches	.0175	Interparietal, width	.009
Breadth of skull at interorbital space	.010	Occiput, height	.0095
Width of rostrum at base	.007	Occiput, width	.008
		Molar-premolar series, length	.008
		Molar series, length	.0055

THE AFFINITIES OF PROTOPTYCHUS.

It has been remarked that fossils do not aid materially in clearing away morphological difficulties, because they raise as many problems as they solve. Such a stricture, while not justified in the case of a nearly complete phylogenetic series, is only too applicable to isolated genera, such as *Elotherium*, or in the case of a few scattered and widely separated links in a phyletic chain. To the latter class, unfortunately *Protoptychus* belongs and there is much about it that is extremely puzzling. It is, in the first place, altogether unexpected to find that the curious and highly specialized family of the *Dipodidæ* should extend back with so little change to the upper Eocene. This is, however, only another instance of the continuity of the American rodent fauna, which, scanty as it is, pursues a much more unbroken course than that of Europe. Still more surprising is it to find that one of the peculiarities which especially mark this family, namely, the inflation of the temporal region and the concomitant reduction of the adjoining cranial bones, have already attained such an advanced degree. Finally, to add to the confusion, we observe that with features characteristic of the *Dipodidæ* are combined certain structures resembling those of the *Heteromyidæ*, such as the dentition and the shape and divisions of the mastoid bullæ, while the infraorbital foramen is like that of the *Muridæ*.

That *Protoptychus* is an ancestral form of the *Dipodidæ* seems abundantly clear. The long, narrow and incapacious cranium, though in strong contrast with that of *Dipus*, is not very unlike the cranium of *Zapus*, and these differences are just what the analogy of other mammalian groups would lead us to expect. The character of the infraorbital foramen offers no difficulty to this view, for its great size in the modern jumping-mice cannot be a primitive feature and the condition found in *Protoptychus* is a starting point from which the modern character of the family could easily be derived. The teeth are, it is true, quite different from those of any of the recent genera, and yet the amount and kind of change necessary to produce the latter are not greater than have demonstrably occurred in many other families. Among the existing jumping-mice there is great diversity in the structure of the molars, which it is difficult to reduce to any common plan.

As yet no member of the family has been detected in the White River formation, but in the succeeding John Day beds the line is carried forward by *Paciculus*. This genus cannot well be directly ancestral to any of the recent genera, because it has lost all the premolars; but in all other respects, in which its structure is known, it stands in an intermediate position between *Protoptychus* and *Dipus*. The molar pattern is already very similar to that of *Dipus*; the infraorbital foramen has become very large and its lower portion forms a distinct notch for the passage of the nerve. The interorbital constriction is much deeper than in *Dipus*, but the cranium has commenced to widen much more markedly than in *Protoptychus*. The incisive foramina and posterior nares remain very much as in the Uinta genus. The posterior part of the cranium in the only known skull is so much injured that the character of the mastoids cannot be made out, though they could not have been as large as in *Protoptychus*, but the tympanics are seen to form large, hemispherical bullæ, with very large meatal openings, which do not form tubes. The lateral view of the skull bears considerable resemblance to that of *Neotoma*, as an ancestor of which *Paciculus* is regarded by Cope.

If the view as to the systematic position of *Protoptychus* which is here advocated be correct, it follows that the *Dipodidæ* were separated from the true mice at a very early period, and that they form a very distinct line. It offers, however, no objection to the inclusion of the jumping-mice among the Myomorpha, for the special peculiarities of the infraorbital canal in the former are shown to be derivative from the murine type. The articulation of the jugal with the lachrymal is probably a primitive feature, which the *Dipodidæ* have retained; this articulation is not only usual among the mammals generally, but is also found in the earliest rodents, such as *Paramys*. Another conclusion which follows from the reference of *Protoptychus* to the ancestors of the *Dipodidæ* is in regard to the position which should be assigned to *Zapus*. This genus displays the skull characteristics of the *Dipodidæ* in a much less extreme degree than the other existing members of the family. This is especially true of the auditory bulla, the mastoid portion of which is very small and but little inflated. If *Protoptychus* be really ancestral to the *Dipodidæ*, then *Zapus* either must have suffered a degradation and reduction of the mastoid elements, or it is not related to the jumping-mice at all. The first alternative is much the more probable one. This mode of development, namely, the advance of a certain structure up to a maximum, followed by a decline in that structure, is not an uncommon occurrence, and is so familiar that it would be superfluous to cite examples here. Such an alternation in the development of one or more parts is compatible with the continually advancing differentiation of the organism as a whole. If this conclusion be well founded, then *Zapus* is not, in any sense, a connecting link between the *Muridæ* and the *Dipodidæ*, but a simplified member of the latter. We have, as yet, no means of determining how far the foot-structure of *Zapus* retains its primitive characters, but judging from the analogy of other groups, it is probable that the foot is primitive rather than retrograde. In very many, perhaps the majority of cases, the skull is modernized earlier than the feet.

A very much more difficult problem is to determine what relation, if any, exists between *Protoptychus* and the *Heteromyidæ*. In most schemes of classification this family and the *Geomyidæ* are referred to the Myomorpha, but several authorities deny the propriety of such a reference. Winge,[1] in particular, rejects the division of the simplicidentate rodents into three sections, and founds his arrangement of the order principally upon the characters of the masticatory muscles and upon the modifications of the skull which accompany these characters. On account of the anterior position of the infraorbital foramen and the imperforate zygomatic process of the maxillary, the "*Saccomyidæ*" (which include both families) are brought into relation with the beavers, marmots and squirrels. The obvious objection to this method of classification is that it ignores the possibility of the independent acquisition of similiar structures in widely separated series, through convergent or parallel development, processes, the reality and frequency of which are not open to question. All available evidence goes to show that in the primitive rodent type the zygomatic process of the maxillary was perforated by a large opening, and that the jugal extended up along the anterior edge of the orbit to the lachrymal. There is nothing impossible in the suggestion that the condition of these parts found in the *Geomyidæ* and *Heteromyidæ* may have been derived from some such arrangement as that which occurs in *Protoptychus*. In the latter the dentition and of difference between them. Certain of his categories are here omitted, as not bearing upon the points to be discussed and some verbal changes have been made to render the nomenclature consistent with that used in the body of this paper.

	GEOMYIDÆ.	HETEROMYIDÆ. (*excl. Heteromys.*)
1.	Skull massive, angular, in general of an arvicoline superficies.	Skull delicate, with rounded off angles and slight ridges, if any.
2.	Interorbital space narrower than rostrum.	Interorbital space much wider than rostrum.
3.	Skull widest across zygomatic arches.	Skull widest across mastoids.
4.	Palate sloping strongly downward, far below level of zygomata.	Palate nearly horizontal, little, if any, below level of zygomata.
5.	Nasals not produced beyond incisors, rostrum broad, blunt, parallel sided.	Nasals produced beyond incisors, rostrum compressed, tapering, acute.
6.	Frontals compressed.	Frontals very broad.
7.	Parietals compressed, irregularly linear, remote from orbits.	Parietals broad, triangular or pentagonal, coming to edge of orbits.
8.	Squamosal roofing most of cerebral cavity, from roof of which mastoids are excluded.	Squamosals mostly or wholly restricted to orbits; mastoids roofing much of cerebral cavity.
9.	Auditory meatus contracted, tubular.	Meatus inflated, vestibular.
10.	Tympanic bullæ widely discrete.	Tympanics approximated or in contact at apices.
11.	Supraoccipital broad, forming most of occipital plane, but not mounting on top of skull.	Supraoccipital contracted, scarcely or not entering occipital plane, but mounting to top of skull to there embrace interparietal between its forks.
12.	Molars rootless.	Molars rooted (except in *Dipodomyinæ*).
13.	Large, erect, falcate coronoid, overtopping condyle.	Small, sloping, prickle-shaped coronoid, below condyle.
14.	Lower jaw large and strong.	Lower jaw small and weak.
15.	Fore-limbs highly fossorial; claws much enlarged, fitted for digging.	Hind-limbs saltatorial. Fore-claws not enlarged or specially fossorial.
16.	Eyes and ears minute.	Eyes and ears large.
17.	Habits completely subterranean.	Habits exposed.

The two families agree in the following respects: (1) The mastoids are much inflated (except in *Heteromys*) and occupy much of the superior or occipital surfaces of the skull, or both. (2) The infraorbital foramen is small and perforates the maxillary far in front of the zygomatic process, which is expanded and imperforate, much as in the Sciuromorphs. (3) The hinder end of the incisor makes a protuberance on the mandible below the condyle. (4) There are large fur-lined cheek-pouches, opening externally.

That the *Geomyidæ* and the *Heteromyidæ* are closely related to one another is admitted by all who have studied them, almost the only difference of opinion on the subject being as to whether they should be grouped in one family or in two. Just wherein this relationship consists is another and less simple question and it may be answered in one of three ways: (1) The *Geomyidæ* have descended from the *Heteromyidæ*; or (2) the latter have descended from the former; or (3) both should be derived from a common ancestor which was not sufficiently differentiated to be properly referred to either family. Improbable as it may appear, the evidence distinctly favors the first of these three alternatives. To regard the manifold resemblances between the two groups as due to parallelism or convergence is a mere assumption which is without any evidence to sustain it. The belief that the *Geomyidæ* have descended from the *Heteromyidæ* involves the inference that the comparatively small size of the mastoid in the former is the result of reduction from a more exaggerated development. The John Day genera *Entoptychus* and *Pleurolicus*, which differ from each other only in the fact that the latter has rooted and the former rootless molars, throw much light on this question. In skull structure they are so nearly intermediate between the two families, that the reference of them to either seems somewhat arbitrary, though, on the whole, they incline distinctly to the *Geomyidæ*, as is shown in the following points of resemblance: (1) The interorbital space is narrower than the rostrum; (2) the palate is sloping and below the level of the zygomatic arches; (3) the nasals are not produced

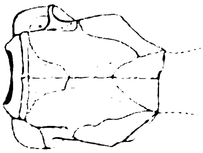

Fig. 5. *Pleurolicus diplophysus*: cranium, from above; natural size. From Cope.

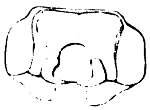

Fig. 6. *Pleurolicus diplophysus*: occiput, from behind; natural size. From Cope.

beyond the incisors and the rostrum is broad, blunt and parallel-sided; (4) the frontals are very narrow; (5) the parietals are narrow, linear and do not extend to the orbits; (6) the supraoccipital does not extend upon the top of the skull; (7) the lower jaw is large and strong; (8) the skull is massive and angular, with well defined ridges and in some species with a sagittal crest. On the other hand, the resemblances to the *Heteromyidæ* are confined to the temporal and occipital regions. (1) The greatest width of the skull is across the mastoids; (2) the auditory meatus is inflated and in some species vestibular; (3) the tympanics form large bullæ and have the anterior flask-like prolongation found in most of the recent *Heteromyidæ*, but their apices are more widely separated; (4) the mastoids are largely inflated and appear on the top of the skull, but roof in less of the cranial cavity than in most of the recent genera; (5) the occiput is almost square and much narrowed by the encroachment of the mastoids. The shape and position of the infraorbital and incisive foramina and the protuberance on the mandible formed by the end of the incisor are as in the modern members of both families. The coronoid process of the mandible is intermediate in character, being larger and higher than in the recent *Heteromyidæ*, smaller and lower than in the *Geomyidæ*. A difference from both is in the shape of the mandibular angle, which is large, falciform and but little everted. The limb-bones, so far as they are known, resemble those of *Thomomys*, except for the presence of the third trochanter on the femur.

These John Day genera are quite inexplicable except upon the hypothesis that they are ancestral to the *Geomyidæ*; to regard them as an offshoot of the *Geomyidæ* which have in some respects paralleled the *Heteromyidæ* is a purely gratuitous assumption unsupported by any evidence. The existing *Geomyidæ* are all exclusively subterranean and fossorial in their habits, with very small eyes and ears, and in them any extreme delicacy of hearing would be out of place. Further, the inflated mastoids of the existing pocket-gophers are intelligible enough as a character acquired under different circumstances of life and retained now in a reduced degree, while it is difficult to see how such a character should ever be acquired by burrowing animals. Another fact pointing to the same conclusion is that, as Merriam[3] has shown in his admirable monograph, the mastoid bullæ are filled with cancellous bone, which there is reason to believe is a sign of degeneracy. Similar reductions of the tympanic bullæ are not infrequent. To give but one example out of many, in the recent peccaries the tympanics form small bullæ filled with cancellous bone, while in the White River ancestor of the group, *Perchærus*, the bullæ are hollow and largely inflated. It is altogether unlikely, on the other hand, that *Entoptychus* and *Pleurolicus* can be ancestral to the *Heteromyidæ*, because, in the first place, the skull and skeleton are too far advanced on the line of the pocket-gophers and indicate that the burrowing habit had already been more or less perfectly acquired, and, in the second place, because in the imperfectly known White River genera *Gymnoptychus* and *Heliscomys* we seem to find distinctly marked forerunners of the pocket-mice.

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[3] Merriam, C. H. Monographic Revision of the Pocket Gophers, etc. U. S. Dep't of Agriculture, North American Fauna, No. 8, Washington, 1895.

SUMMARY.

(1) *Protoptychus*, a new rodent from the Uinta Eocene, is an unexpectedly modernized form, which has already acquired very large mastoid bullæ, a rostrum, incisive foramina and posterior nares greatly resembling those of the jumping-mice, and, as in that family, the articulation of the jugal with the lachrymal is retained. The infraorbital foramen is of the murine type. The dentition and the shape and construction of the mastoid and surrounding parts of the cranium most resemble those of the *Heteromyidæ*.

(2) The genus is probably to be regarded as the ancestral type of the *Dipodidæ* and indicates an American origin for this family, being much more ancient than any known representative of the group in the Old World, which it appears to have reached by a

THE JELLY-LIKE SECRETION OF THE FRUIT OF PELTANDRA UNDULATA Raf.

BY IDA A. KELLER.

Having some time ago determined the origin of the thick coating of jelly investing the younger parts of *Brasenia peltata*, Pursh,[1] I was curious to seek the cause of a similiar secretion found in the fruit of *Peltandra undulata* Raf., a plant widely separated from the former so far as its natural relationship is concerned.

The stage of development which first attracted my attention to the voluminous secretion of this plant is represented in fig. 1, Pl. XII, where *a*, *b*, and *c* show three different views of the same plantlet. Above may be seen the first leaf, *l*, thick, green and cotyledon-like. Within this, and partly protruding beyond it, the second leaf, *l. b.* The portion circumscribed by a rather wavy outline, *j.* is the jelly-like mass in question. Roots are also beginning to emerge, as indicated by *r.*

The question naturally arose, from what portion of the fruit does the jelly originate? Is it produced from special glandular organs as in the case of *Brasenia peltata* Pursh, or is it the result of a metamorphosis of certain cells into this peculiar gelatinous mass without the intervention of glands? Before proceeding to answer these questions I will briefly outline the anatomy of the fruit of this plant. The fruit of the members of the Araceæ family is, as we are told, usually a berry. It appears to me, however, that the most essential characteristic of this type of fruit, the well developed mesocarp, enclosing the seed as a fleshy mass, is here conspicuously reduced. The whole mass of tissue representing the pericarp, consists of a few layers of cells, represented in fig. 2. It has the appearance of a thin integument such as we find in a caryopsis or utricle rather than that of a pulpy envelope. The material which I had at command was, as a rule, one, or rarely two-seeded. Fig. 3 shows such a one-seeded fruit cut through lengthwise. The spherical embryo is represented by *e.*; below *e.* is an empty space, *v.* Between the seed and the pericarp is found a mass of jelly, which, it should be noted, is present before germination.

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[1] Proc. Acad. Nat. Sci., March 28, 1893.

In my search for the origin of this jelly-like secretion, I observed that it adhered firmly to the seed-coat, and I was inclined to believe that possibly the latter might in some way give rise to this substance. On examination I found no trace of glandular organs upon the episperm nor did the outer cells themselves indicate gelatination. I continued my search, however. Fig. 2 sufficiently indicates that we find neither special glands nor metamorphosed cells in the portion of the pericarp represented in the drawing. It represents almost any part of the pericarp, except that which I shall now describe. My attention was next directed to the thickening, *n.*, fig. 3, which corresponds to the point of attachment of the fruit to the spadix. This is brown in color and quite rugose. On making sections I found that the wrinkles or folds are thickly beset with trichomes, shown in fig. 4. They are more or less club shaped, of a brownish color, especially *en masse*, and of a varying size. In general appearance there is a striking resemblance to the glandular hairs producing the gelatinous coating on the young leaves of *Brasenia peltata* Pursh, and I have no doubt that the jelly-like secretion of the fruit of *Peltandra undulata* Raf. owes its origin to those glandular trichomes situated in the basal thickening of the pericarp. This view was confirmed by subsequent observations, especially during the process of germination. The first indication of germination is probably the swelling of the jelly-like mass, thereby rupturconstituent of every gelatinous secretion, is in this particular case, in *all* probability, derived directly from the water surrounding the plant than that which is carried through the tissue of the plant to the glandular organs. The secretion in the fruit of *Peltandra undulata* Raf. is not in close contact with an aqueous medium, and it appears to me a significant fact that the tissue upon which the glands of this plant are supported is traversed by spiral vessels, being thereby well supplied with water-conducting tissue. The water in this case must of necessity be carried through the plant to the interior of the fruit.

A few more observations deserve a passing notice: When I collected my material for study October 7, 1894, I observed that some of the fruits had left the spadix while others still crowded around it surrounded by the tough spathe. About a dozen of the seeds I threw into a jar containing water. Of these only three survived and germinated in March of this year. Figs. 8 and 9 are drawings of seedlings as they appeared on April 15, and the plants continued to live until the beginning of May, although they had no soil to root in.

On April 18, of this year, Mr. MacElwee showed me a locality near Gray's Ferry Station where *Peltandra* grows. Although the seeds which I had collected last year had germinated a month ago, we found that most of the seeds at this locality just barely showed the protruding tip of the first leaf, and some showed no signs whatever of sprouting. It cannot be said that the appearance of the jelly is invariably the first indication of activity in the seed, since I noticed repeatedly that the bud may appear while the secretion is still encased in the pericarp. The plantlet represented in fig. 8, did not throw back the pericarp either during germination or afterward.

Some of the fruits were placed on very wet sand and in a few days there were signs of vigorous growth, fig. 10. Others were thrown on water, and, although development took place, fig. 11, it did not seem as healthy as when the fruits were allowed to rest upon a solid, although thoroughly wet, substratum. The difference may be appreciated on comparing figs. 10 and 11, and this difference became more marked later on.

So far I have not found any satisfactory explanation for the development of this peculiar jelly-like secretion in the fruits of *Peltandra undulata* Raf., its persistence during germination, and its disappearance afterwards. It is probable that its function is protecti but the problem as to the special protection needed in this particu case, can be best solved by observing the germination of the s in its natural environment.

JUNE 4.

REV. HENRY C. McCOOK, D. D., Vice-President, in the Chair.

Thirty-seven persons present.

JUNE 11.

REV. HENRY C. McCOOK, D. D., Vice-President, in the Chair.

Nineteen persons present.

JUNE 18.

MR. CHARLES MORRIS in the Chair.

Fifty-four persons present.

JUNE 25.

REV. HENRY C. McCOOK, D. D., Vice-President, in the Chair.

Eighteen persons present.

A paper entitled "Diptera of Florida, by C. W. Johnson; with additional descriptions of new genera and species," by D. W. Coquillett, was presented for publication.

The following was ordered to be printed:

MEMOIR OF JOHN HOWARD REDFIELD.

BY THOMAS MEEHAN.

The task assigned to me by the Academy of preparing a suitable memoir of our late fellow-member, John Howard Redfield, is not an easy one. To make famous one who sought not fame; and to tell to the world of science the story of the life of one whose modesty and self-abnegation scarcely allowed him to appreciate the value of his own work, is surely a difficult undertaking. It has been my fortune to have an acquaintance with mankind to an extent enjoyed by few; with men and women famous in many walks of life; but I have rarely known one who worked with such an earnest purpose to be useful, and who was at the same time so indifferent as to whether the world knew of it or not, or whether he received credit for the work which he had done. Associated with him as I have been in the botanical work of the Academy since the early sixties, and I may say closely connected with him in that work for the past twenty years, I am amazed, now that he is gone, when I think of how little I know of the man beyond his own beloved personality in connection with that work. Once only did he stop to tell me of his was thus led ultimately to discover the rotary motion of storms and tornadoes; how the simplest elements of knowledge only were taught in the district school by peripatetic teachers who boarded around, and taught during the terms, Lindley's English Reader, Milton's Paradise Lost, the Bible and Cook's Voyages being nearly all the books within reach. Among all these varied teachers he remembered two women, to whom he was especially indebted for his love of flowers and nature. They fixed in him his earlier tendencies and he was emphatic in his belief that for boys under ten years of age good women, all other things being equal, rather than men, make the best teachers. His father brought him from New York a Latin grammar and reader, and he tried in a measure to teach himself. He was now at an age—ten years—to appreciate the value of knowledge, and would recite his lesson to the minister of their church. A literary society was founded in the vicinity, encouraged mainly by his father, and it was, he thought, this little institution which made a man of him, though there were not over three hundred volumes in the library. One of these books was Thornton's Grammar of Botany. He felt himself something of a botanist from that time. His father subsequently moved to New York. Here a school on the Lancasterian system was established, a system in which the advanced boys, as monitors, aided in teaching the classes; but instead of the mere elementary studies in the general Lancasterian system, a higher school was established in which mathematics, drawing, bookkeeping, the ancient and modern languages, and something of a business collegiate course was attempted. His father having met with financial reverses, the boy had to leave school when fourteen years of age and help to support himself by entering as a clerk in a dry goods store, his work being to clean, dust and deliver parcels. Thus he passed three years, keeping up, however, his early habit of self-culture in all his spare time. The story was so interesting that I made a note of it, and this is all our good friend ever said to me of himself.

I was elected a member of the Academy in 1860, and at once applied myself to assist Mr. Elias Durand, who alone seemed interested in the herbarium at that time. Mr. Redfield, a few years later, though actively engaged in business, made a practice of dropping in for a short time at noon, daily, to give encouragement by his presence at least. This was my first acquaintance with him.

Mr. Durand died soon after. The collection was in a deplorable condition. Mr. Durand had been very generous of his time and abilities, but all he could do was in connection with the North American herbarium. The building was on the line of a dusty street, and the dust-covered packages of genera or natural orders were quite repellant. Mr. Redfield's cheering calls were bright spots in my lonely task. I tried, however, to interest some of my correspondents in behalf of the herbarium. Dr. Gray's reply was suggestive. "What is the use of throwing valuable material into a dust bin?" I was pondering over the note when Mr. Redfield made his daily call. "Never mind that," said he, in his cheery manner, "I shall have more time soon, and the new building is to go up near my residence. We will show them what sort of a 'dust bin' we shall have after a while." From this time he began active work on the herbarium, looking at first into the few collections, and commenced the great task he imposed on himself, resulting in giving us a herbarium of which botanical science everywhere is proud. His intelligent earnestness made friends for the Academy everywhere, and it is pleasant to note that among all these friends no one was more liberal or generous than the author of the "dust bin" note. With the exception of the three summer months when he took a vacation to northern sea shores, every day was given to herbarium work, while many of his evenings were devoted to correspondence with botanical friends all over the world. At his death he had catalogued and indexed so that any specimen can be examined in a few seconds, the whole collection numbering some thirty-five thousand species of flowering plants and ferns. He had, with the aid of an assistant, verified and fastened one-half of the specimens.

The Academy is indebted to John H. Redfield not only for his great labors in behalf of the herbarium, but for the influence of his personal character. His amiable qualities endeared him to every one with whom he came in contact; his generous helpfulness, especially to younger botanists, carried gratitude to many distant regions; eminent men from all parts of the world honored him and gave him pleasure by calling on him and enjoying his hospitality when passing through the city. The Academy profited by the many gifts of plants made as a tribute to his worth. It is probable no one ever heard Mr. Redfield make an ill-natured remark of another even under temptation. Always full of good humor, he would even in a controversy incline by some pleasant remark to allow the verdict to go against himself. In this connection he was fond of repeating an anecdote. A Scotchman returning to his native village inquired of the sexton the state of affairs. The sexton sadly reported the decadence of religion. In his opinion the only adherents of the true faith were himself and the dominie, and sometimes he had "doots" about the minister himself. He would suggest that perhaps he might be as critical of the views of his friends as Sandy was. Loving appropriate stories to illustrate his points, he enjoyed them when used by others. He often quoted from Dr. Gray, who, like himself, was overflowing with good nature. Mr. Redfield had asked him to let him have some duplicates if there were any. It happened that there was but a single set, and no duplicates. Dr. Gray's pleasant response was: "As the boy said when the other hoped for a bite of the apple, and modestly asked for the core, 'Billy, there ain't goin' to be no core in this apple.'' Such humorous stories usually came in when it was evident further discussion was hopeless of results.

There were, however, a few topics on which his exceptional good nature would admit of no compromise, even in the way of a pleasant remark of no great consequence either way. One of these was the well-meaning effort of some botanists to strictly enforce the rule of priority in botanical nomenclature. To him, Conservator of a great herbarium, the effort admitted of no joke. The older names to replace those long adopted were so numerous, that the revolution meant to him the comparative uselessness of his life-long work. There must be new numbers, new lists, new names on the sheets, new alphabetical indexes. He could not begin that great work of change at his time of life, nor could he see anyone in prospect who would. He vigorously contended that there must be something wrong in an effort that would render such life-work as his comparatively useless. Commendations for the stand he had taken in this matter were among the greatest pleasures of his latter days.

Since his active connection with the Academy, he seems not to have taken many long botanical excursions. One, however, the pleasure of which he loved to recall, was made in the summer of 1876, in company with Mr. W. M. Canby, Dr. Asa Gray, Dr. Engelmann and Prof. C. S. Sargent, through the mountains of North Carolina, the result of which considerably enriched the herbarium of the Academy. In 1879 he made another journey to North Carolina with Dr. Gray to see where *Shortia* grew. One may see from the scrupulous care with which every fact of importance is noted on the labels attached to the plants collected on these journeys how well trained to conscientious accuracy his mind had been. His work for the day would be finished and cleared up as if he never expected to resume it again ; and when he undertook a task his mind dwelt on it until the end had been reached. Happening, while penning these lines, to open a volume on my table treating of the Celastraceæ, I find a letter between the pages which well illustrates this finished character. We had together been working up an unnamed collection from Tabasco in Mexico. Leaving in the afternoon, I expected to be again in the herbarium the next or at most the day after. But he could not wait, and the letter came the next morning: "Phila., March 3rd, 1893. My Dear Meehan : I enclose you two or three softened flowers of our last *adversarium* for you to examine. As *I* see them, they have five rounded imbricate sepals, five strongly reflexed petals, five stamens *alternate with the petals*, filaments conical, no style, but stigma sessile on the ovary. The ovary is too small for my poor eyes to dissect.

Try every way I can, I am driven back to Celastrinæ, and I have a suspicion that our plant *may* be *Zinowiewia integerrima* Turcz. B. & H. I, 364. B. & H. description says "*stylus brevis*," but the original description says "stigma sessile on the ovary." B, & H. say "folia opposita," but if I recollect right, the original description says "leaves alternate." But there are some difficulties about this view. Yours, J. H. R."

On some other occasion, when we would feel the "nut too hard to crack," I would hardly be home before there would be a brief note, "Eureka!" and the name following as he had determined it. It must be to this habit of beginning and finishing at once if possible, that we must ascribe the wonderful amount of work accomplished. He commenced the work of putting the herbarium in order in 1870. In addition to the preparation for fastening down the specimens and the accompanying label, on which work he was engaged at the time of his death, he had previously arranged in genus-covers the whole collection, writing on each the genus and the numbers to correspond with Bentham and Hooker's work.

and made a corresponding index of classes and orders, so that any genus could be found in a few seconds. All the species had been alphabetically arranged in the genus covers, and an alphabetical list of the named species pasted inside. Anyone can see at a glance whether the plant he is looking for is in the collection. Besides this, in the section of ferns, the whole collection is written up in a handsome bound volume, with an index that not only enables one to find at once the plant desired but also its geographical range and many other facts of importance to the student of pteridology. By reason of this careful cataloguing he was able to tell exactly the number of species the herbarium contained, information few care-takers of herbariums can give. A careful record was kept of every donation, and the donors' names, like the names of the plants themselves, could soon be given to any inquirer. And yet he never seemed unduly hurried. In addition to this he had formed a great herbarium of his own, and had made extensive collections in other fields of natural history. Moreover, he maintained to the last an interest in many other branches of science and in the many fields of general intelligence that commanded the attention of public spirited citizens. He was fond of looking up facts in the lives of useful men, placing them on record, and getting in shape for reference any good work that they had done. He prepared for his family a full genealogy of their ancestry. Another valuable task that he accomplished was the collection and arranging of the botanical correspondence of Zaccheus Collins, which precious volume is kept for safety in the fireproof of the Academy. The work is invaluable for the light it sheds on the lives and labors of our early botanists. When Michaux's Journal was discovered among the archives of the American Philosophical Society and Prof. Sargent decided to translate it from French to English, and have copies printed, he aided the Professor in overseeing its issue from the press. He was always ready for every such call.

It seems but yesterday that I heard his last remark to me: "I must lay these aside now, as I will attend the Forestry Convention at 4 o'clock," and even the last letter he wrote to me on his death bed was full of his work. "I felt chillier than I ought to be when I was in the herbarium room on Friday, and went home. I am resting in bed now, and the Botanical Section meeting to-night must take care of itself." To many who have since paused to reflect on the wonderful amount of work accomplished, his methodical and systematic habits furnish the only explanation. Frequently he has been approached by friends to allow the use of his name for the higher honors of the Academy. This he always declined. He could never be induced, even in the Botanical Section, to accept any higher position than Conservator of the herbarium. He served many years as Councillor, in which position his business training rendered eminent service, and he succeeded Dr. Joseph Leidy as Chairman of the Publication Committee of the Academy.

Aside from his services to science in the Academy, the outer scientific world is largely his debtor. When the American Society of Geologists became the American Association for the Advancement of Science, the father, W. C. Redfield, suggested the change and was the first President of the new body, the son being a member. The Lyceum of Natural History of New York had the benefit of his able services before his removal to Philadelphia, in 1861, to be associated in the business of Asa Whitney & Sons —the senior member of the firm being his father-in-law. At the request of his family he penned for them an account of his early history and of his connection with the New York Lyceum, which I have been kindly permitted to examine, and from which I gather the following facts. In the preface to this little family task he concludes: "Moreover ought I not to leave some expression of gratitude to my Heavenly Father for a life which has been so full of apprenticed to a saddler, joined a village debating society, and, under the inspiration of his mother, spent all his spare time in self-instruction.

J. H. Redfield was born at Middletown, Conn., July 10, 1815. His mother died when he was but four years old. His father at this time had a saddler's shop and country store. His early education has been already told. In this account Mr. Redfield notes that every country store sold liquor, but in 1830 his father refused, as a matter of conscience, to sell any more. About 1825 his father becoming interested in steam barge traffic on the Hudson, spent most of his time in New York, and in 1827 took his family there. John was sent to a Lancasterian school. It furnished good, although cheap, education—($51.50 a year). The principal teacher, Rev. Samuel C. Barnes, originally a Baptist clergyman, gave natural history lessons on the blackboard. He gave J. H. Redfield and six other boys extra lessons in mineralogy, taking them on excursions on Saturdays. Barnes was one of the founders of the New York Lyceum. He used to join in the sports of the boys as well as their studies, and for the first time in his life young Redfield loved school.

The father took every means to advance the son's education as opportunity afforded. Though personal assiduity did much, he owed much to the teachers employed by his father for him. He had this help in the several languages he acquired, the Italian, which he mastered late in life, being the only one he learned wholly by himself. In 1853 he left school finally and became a clerk in the "Swift Sure Line" of steamboats. His father died in 1858, but he continued in the office three years longer, till removing to Philadelphia.

The New York Lyceum was organized April 24, 1817, and became the New York Academy of Sciences in 1876. As a new member of the Lyceum young Redfield thought a tyro had made a mistake in venturing among great men, but he found them all so child-like and genial that his agitation was soon dispelled. Dr. Asa Gray, the librarian, was especially cordial. Young Redfield had his first scientific appointment as one of a committee to rent a room. It was thought wonderful that twenty-four members assembled to receive the committee's report. His father gave occasional addresses on meteorology and geology. Dr. John C. Jay first made conchology interesting in the Lyceum and Redfield became charmed with that study. His father was second Vice-President of the Lyceum of Natural History from 1847 to 1851, and first Vice-President from 1852 to 1863, and the son was Corresponding Secretary from 1859 to 1860 and previously, from 1857 to 1858, Recording Secretary. He notes Dr. Asa Gray, at that time 26 years old, as coming into the Lyceum about 1853. Dr. Torrey was an early friend of W. C. Redfield, so the son knew him before he joined the Lyceum. Though botany was the son's early love, threatened impairment of eye-sight diverted him to conchology. He soon became again warmly interested in botany, rising for collecting excursions at four in the morning.

Passing now to his labors with us, it may be noted that he rarely missed a meeting of the Academy, and was one of the most regular in throwing into the general fund such knowledge as he possessed on the subjects discussed. He may be regarded as the chief founder of the Botanical Section, and he gave freely of his knowledge in most of the discussions before the Section. Reports of many of his verbal communications have been published in the Proceedings of the Academy.

His first contribution to scientific literature was in 1860, when he described a new shell—a species of *Marginella*. He furnished the notes on the genus *Marginella* as described in Reave's Conchologia Iconica and in Tryon's American Journal of Conchology in 1869 and 1870. His nine earlier papers in the Annals of the New York Lyceum, relate wholly to conchological subjects. The "Bulletin written on March 18, but a short time before his own death, remarked on the peculiar modesty of Mr. Redfield: "He never, within my hearing, made his own acts a subject of conversation or reference." Mr. E. L. Rand, his colleague in the preparation of the "Preliminary Catalogue," sums up briefly what so many have expressed more in detail: "Circumstances threw us into the most intimate correspondence and association during the last seven or eight years and made me familiar with his beautiful character. He was always high-principled, simple-hearted, charitable, kind and helpful, an affectionate friend, a wise counsellor, an upright judge. I can hardly realize that he is really gone from this earth, and that I am left alone in the work that we pursued so long together."

February the 27th, 1895, the day on which he passed away, will long be remembered in the annals of the Academy as the anniversary of the loss of one of its most valuable and devoted associates.

JULY 2.

Mr. Charles Morris in the Chair.

Fourteen persons present.

The deaths of H. H. Houston, a member, June 21, 1895, and of Thomas Henry Huxley, a correspondent, June 29, 1895, were announced.

JULY 9.

Dr. Geo. H. Horn in the Chair.

Twelve persons present.

JULY 16.

Mr. Charles Morris in the Chair.

Twelve persons present.

JULY 23.

Dr. C. N. Peirce in the Chair.

Nine persons present.

A paper entitled "Notes on American Enchytraeidæ.—I, New Species of Fridericia from the vicinity of Philadelphia," by J. Percy Moore, was presented for publication.

JULY 30.

Dr. Geo. H. Horn in the Chair.

Eleven persons present.

The following were ordered to be printed:—

DIPTERA OF FLORIDA.

BY C. W. JOHNSON.

With Additional Descriptions of New Genera and Species.

BY D. W. COQUILLETT.

This paper is based upon material collected during a residence in St. Augustine from 1880–88 (although then not especially interested in Diptera); a visit in March, 1891, and again in May, 1894; a collection made by Mrs. Annie T. Slosson during her winter visits; the collection of Mr. Chas. Robertson, of Carlinville, Ill.; an interesting lot received from Mr. Frank H. Genung of St. Augustine, and the collection of the U. S. National Museum. The trip of May, 1894, was a conchological one, made in company with Prof. H. A. Pilsbry, through the kindness of Mr. Clarence B. Moore, Diptera being an incidental feature. The localities Welaka, Georgetown, Drayton Island, Juniper Creek, Volusia, Astor, and Tick Island are all in the vicinity of Lake George and Lake Woodruff. Considering the few species that have actually been recorded from Florida the following list seems a large one, but there is little doubt that this number (504) can be increased more than three times if collections were made in all sections of the State and at different seasons of the year. A number of West Indian species are here recorded from Florida for the first time as well as the most southern distribution of many northern species. A collection from the Florida Keys would undoubtedly increase the percentage of West Indian species, while the western part of the State would add many more species of the Mississippi Valley, Texas, and Mexico.

While a resident of Florida I was interested in Coleoptera, and the valuable paper, "The Coleoptera of Florida," by Mr. E. A. Schwarz, suggested this list. I only regret that it is not a more complete representation of the fauna, but hope that it will lead to a better knowledge of the Diptera of Florida.

I am under great obligations to Mr. D. W. Coquillett of Washington, D. C. Without his generous aid this list could not have been made. To Mrs. Slosson for the generous loan of specimens. To Prof. J. M. Aldrich for the determination of the Dolichopodidæ. To Prof. Riley for the privilege of looking over the collection of the U. S. National Museum, and to Mr. Chas. Robertson, Mr. W. A. Snow, Dr. S. W. Williston, Mr. W. D. Hunter, and others, for kind assistance.

DESCRIPTIONS OF NEW SPECIES.

BY C. W. JOHNSON.

Nemotelus immaculatus n. sp.

Length 4 mm., ♂. Face and vertical triangle blackish; eyes of a dull brown color (probably much lighter than in the living specimen); antennæ yellow; proboscis red, unusually long, with an acute angle, the two portions thus formed being of almost equal length, the outer half is curved downward and the basal part of the other is somewhat enlarged. Thorax black, with sparse whitish pubescence most prominent on the pleuræ; scutellum black; abdomen greenish white, immaculate. Legs light yellow; wings hyaline, whitish. One specimen, St. Augustine (F. H. Genung).

Nemotelus slossonæ n. sp.

Length 3 mm., ♂. Face and vertical triangle black, shining; facial protuberance very prominent, conical; frontal triangle brown. The upper portion of the eye with large facets brown, the lower third with small facets blackish; antennæ dark brown. Thorax and scutellum black, shining; a narrow light yellow lateral line extends boscis black, base yellow; antennæ yellow, terminal joint and style black. Thorax brown, dorsum shining; lateral margins, pleuræ, posterior angles, and scutellum covered with a grayish pubescence. Abdomen: first segment blackish with a prominent row of bristles at the posterior margin, second and third segments brown, the remaining segments blackish with more or less brown at the anterior and posterior margins, and covered with a grayish pubescence. Venter brownish. Legs reddish, thickly covered with minute yellow hairs, and dark brown spine-like bristles on the tarsi; claws black, bristles on the tibiæ yellow; wings of a uniform dark brown, veins black. Two specimens, St. Augustine.

Asilus auratus n. sp.

Length ♂ 12 ♀ 15 mm. Face and front light yellow pollinose; facial protuberance with long whitish bristles; occiput light yellow pollinose, and long white pile, which in some specimens is brownish near the vertex; a row of black hairs extends along the frontal orbits; ocelli black; proboscis black; antennæ reddish, first and second joint with numerous black hairs, third joint and arista brown. Thorax golden yellow pollinose, with a wide dorsal stripe that is attenuated and obsolete (in certain lights) towards the scutellum, some specimens show an obsolete linear interval of a lighter color, thus dividing the stripe into two parts; the entire dorsum with short black hairs; a few long, black and yellow bristles are arranged as follows: four on the side just before the suture, the others in a lateral and two subdorsal rows on the posterior half of the thorax, scutellum yellow pollinose, with black hairs, and two yellow bristles; pleuræ, and coxæ, yellowish white pollinose. Abdomen yellow pollinose; covered (except at the base of the first, and a wide basal and posterior margin on the second, third and fourth segments) with black hairs; the smooth basal bands on the second, third and fourth, have two transverse rows of punctulate spots, one of the rows is often covered on the third and fourth by the preceding segment; near the posterior margins of the segments is a row of black and yellow bristles; hypopygium red, shining, with whitish hairs, ovipositor black, shining. Legs red; with close-lying whitish hairs and prominent black and yellow bristles, tip of the femora with a spot on each side, tip of the posterior tibiæ, and tip of all the tarsal joints blackish; claws black, pulvilli red. The base, and discal portion of the wing clear hyaline, leaving the tip and a wide posterior border of a brownish tint. Seven specimens, Palatka, May 19, St. Augustine, May 21, 1894.

Calobata varipes n. sp.

Length 14 mm., ♀. Head bluish-black, shining, opaque with black pile above and below the antennæ; vertex, in a depression surrounding the ocelli with dense yellowish pubescence, vertex with eight prominent bristles; occiput with black pile; antennæ red, setæ black, first and second joints covered with short black hairs; proboscis black. Thorax black, posterior angles brownish, dorsum with a grayish pubescence, leaving two narrow black stripes which become obsolete beyond the sutures, pleuræ black, shining, metapleuræ and metanotum covered with whitish pubescence. Scutellum blackish above, brown beneath. Abdomen black, shining. Coxæ and femora red; tip, and a band a little beyond the middle of the posterior and middle femora and the apical third of the anterior femora black, anterior and posterior tibiæ black, middle tibiæ brown, first and second joints of the anterior and posterior tarsi white, the remainder of the anterior and posterior tarsi, and the entire middle tarsi black; the legs are covered throughout with short, black hairs, with some bristles on the tibiæ. Wings tinged with brown, which is more conspicuous along the anterior margin, tip and cross veins.

One specimen, Jacksonville, May 22, 1894.

Heterochroa ornata n. sp.

Length 2½ mm., ♀. Face, front and occiput yellow, with yellow pubescence; a row of black bristles extends from the base of the antennæ along the frontal and vertical orbits and around the occiput, four bristles are arranged in a quadrangle around the ocelli; ocelli whitish; antennæ yellow, aristæ and a prominent row of hairs on the second joint black, aristæ with minute hairs. Thorax and scutellum yellow, with yellow pubescence, and black hairs and bristles. Abdomen brownish black, irregularly mottled with whitish pubescence with a few scattering black hairs, which gives the white portions a punctated appearance. Legs yellow, with black hairs and bristles. The basal portion of the wing, including the costal cell, a small angle of the marginal, submarginal, and half of the basal cell, anal angle, and alar appendage, hyaline; the remainder of the wing clouded with black, and having the following whitish hyaline markings: marginal cell with three spots, the middle one quadrate, and three or four times the size of the others; submarginal cell with three spots, two below the large quadrate spot of the marginal cell, and one at the end of the second longitudinal vein; first posterior cell with four, one at the posterior cross vein, two smaller ones midway between the first and the large one at the tips of the wing, the latter occupying the entire width of the cell; second posterior cell with four occupying the central portion, the larger ones coalescent; third posterior cell with three spots, the large middle one triangular; discal cell with two, the outer one three or four times the size of the others.

One specimen, Drayton Island, May 9, 1894.

DESCRIPTIONS OF NEW GENERA AND SPECIES.

BY D. W. COQUILLETT.

tyura elegans n. sp., ♂ ♀.

Head black, lower part of front and the face yellow; antennæ black, the two basal joints yellow; proboscis yellow, its apex and the palpi black. Dorsum of thorax opaque brownish black, the sides, pleura and scutellum, yellow; metanotum brown, this color extending upon the pleura to the middle coxæ. Abdomen shining brownish-black, the first segment, both ends of the second, apices of the third and fourth, and the whole of the fifth, yellow; first five ventral segments also yellow. Halteres and legs yellow, tibiæ destitute of bristles. Wings grayish hyaline, marked with two irregular brown crossbands and with two brown spots; the first band begins at the first vein before its tip, is interrupted between the branches of the fifth vein, and stops before reaching the hind margin of the wing, its posterior portion scarcely half as wide as the costal part; the second band starts from the tip of the third vein and stops at the anterior branch of the fifth a short distance before its tip, where the band is scarcely one-fifth as wide as at the costa; midway between these two bands is a large brown spot reaching from the anterior branch of the fifth vein to the hind margin of the wing at the tip of the posterior branch; a brown cloud on anterior branch of third vein, this branch terminating at twice its length beyond the tip of the first vein. Length 3.5 mm.

Georgetown, Florida, May 10, 1894 (C. W. Johnson); North Carolina. A single specimen of each sex.

The specimen from the latter locality is from Dr. Riley's collection, now in the National Museum.

Neoglaphyroptera cincta n. sp., ♂.

Head, including the mouth parts, yellow, each ocellus situated on a black spot, the median very small; antennæ yellow on the six basal joints, the remainder blackish. Thorax, pleura and scutellum yellow, a large black vitta at base of each wing extending across the metanotum. Abdomen shining black, base of each segment and the whole of the sixth and seventh, yellow. Legs yellow, bristles of front tibiæ minute, those of the others large. Wings yellowish hyaline, unmarked; third vein issuing from the first slightly beyond the forking of the fourth. Length 4.5 mm.

Tick Island, Florida, May 12, 1894. C. W. Johnson. A single specimen.

Ceratopogon albaria n. sp., ♀.

Head black, the face and mouth parts yellowish; antennæ brown, the basal joints yellow. Thorax, pleura and scutellum black, densely opaque white pollinose. Abdomen black, subshining. Legs yellow, both ends of the femora and tibiæ, apices of first three tarsal joints, and the whole of the last two joints, brown; last tarsal joint ciliate on the under side with rather long setæ, the claws subequal in length, slightly over half as long as the last tarsal joint. Wings whitish hyaline, vein sconcolorous excepting the small cross vein and base of third vein, which are narrowly clouded with brown; submarginal cell divided near its first fourth by a cross vein situated nearly three times its length before the tip of the first vein; fourth vein branching the length of the small cross vein before the latter, at a point slightly beyond the branching of the fifth. Halteres yellow, the knobs each marked with a black spot. Length 3 mm.

Drayton Island, Florida, May 9, 1894. C. W. Johnson. A single specimen.

Tanypus concinnus n. sp., ♀.

Light yellow, three vittæ on the thorax reddish yellow, the middle one bordered each side with black, the lateral ones changing into black posteriorly; a dot at each front angle of the scutellum, middle of metanotum, a fascia at base of each abdominal segment except the first, apices of tibiæ, of metatarsi, of the second joint of the middle and hind tarsi, the whole of the remaining joints and the last four of the front tarsi, black. Penultimate joint of hind tarsi obcordate, as broad as long. Wings naked, whitish hyaline, veins pale yellowish, small cross vein clouded with brown; first vein forked before its apex, the fifth forking slightly beyond the cross vein. Length 3 mm.

Tick Island, Florida, (May 12, 1892; C. W. Johnson). A single specimen in Mr. Johnson's collection.

Masiphya aurigera n. sp. ♂.

Black, the second antennal joint, base of the third, the palpi, and fourth abdominal segment except its base, yellow. Front at vertex hardly two-fifths as wide as either eye, vitta next the antennæ nearly as wide as either side of the front, the latter and the face golden pollinose; frontal bristles descending to tip of second antennal joint, four in each row curving backward; antennæ nearly two-thirds as long as the face, the third joint slightly over twice as long as the second; arista thickened on the basal fourth; vibrissæ at a point twice the length of the second antennal joint above the oral margin, ridges bristly on the lower fourth; proboscis robust, the portion between the basal articulation and the large labella scarcely longer than the latter. Thorax gray pollinose, marked with four black vittæ; four postsutural and three mesopleural macrochætæ; scutellum bearing six pairs of long marginal macrochætæ. Abdomen gray pollinose, with brownish reflecting spots, genitalia only slightly protruding; first and second segment bearing a marginal pair of macrochætæ, third with a marginal row, the fourth with scattered macrochætæ on the apical two-thirds. Hind tibiæ not ciliate, destitute of long hairs on the inner side, pulvilli as long as the last tarsal joint. Wings hyaline, slightly tinged with gray basally, third vein bearing four bristles at the base, the others bare; bend of fourth vein destitute of an appendage. Length 11 mm. Florida. Mrs. A. T. Slosson. A single specimen.

TACHININÆ.

PSEUDOCHÆTA n. gen.

Anterior pair of ocellar bristles wanting, two pairs of backwardly curving orbital bristles in both sexes and an additional pair of forwardly directed ones in the female; the upper pair of frontal bristles is on a line with the backwardly curving orbitals and considerably removed from the other frontals which are much smaller and decussate, extending from the lowest ocellus to the arista; antennæ as long as the face, the third joint in the male five times, in the female three times as long as the second; arista bare, the penultimate joint not longer than broad; head at insertion of vibrissæ half as long as at base of antennæ, face in profile convex, the sides bare, each at the narrowest part one-eighth as wide as the median depression, ridges bristly on the lower four-fifths; vibrissæ widely separated, inserted on the oral margin; cheeks one-seventh as broad as the eye-height, the lower half covered with short bristly hairs, the usual row of macrochætæ on the lower border; eyes microscopically pubescent; proboscis robust, the portion beyond the basal articulation not half as long as height of head, labella very large; palpi clavate, well-developed. Abdomen oblong-oval, of four segments which are subequal in length. Hind tibiæ outwardly ciliate with short bristles intermixed with two or three longer ones. Third vein bearing a few bristles at the base, the others bare; apical cell open, ending at four-fifths of the distance betwwen the second vein and the extreme wing-tip; bend of fourth vein obtuse, destitute of an appendage; hind cross vein slightly nearer to the bend than to the small cross vein, its posterior end nearer to the wing-margin than to the small cross vein. Type, the following species:

Pseudochæta argentifrons n. sp. ♂ ♀.

Black, including the mouth parts. Front at vertex about as wide as either eye, vitta next the antennæ two-thirds as wide as either side of the front, the latter and the face densely silvery pollinose, antennal arista thickened on the basal third. Thorax gray pollinose; marked with four black vittæ; four postsutural and two sternopleural macrochætæ; scutellum bearing three pairs of long marginal and a pair of short apical macrochætæ. Abdomen shining except the grayish pollinose bases of the last three segments; first two segments each with a marginal pair of macrochætæ, third with a marginal row, the fourth with scattered macrochætæ except on the basal fourth; genitalia not projecting. Pulvilli scarcely half as long as the last tarsal joint. Wings hyaline, calypteres grayish white. Length 5 mm. Charlotte Harbor, Florida (Mrs. A. T. Slosson), and Los Angeles, California (D. W. Coquillett). Four males and three females.

Achætoneura rubentis n. sp. ♀.

Front at vertex three-fourths as wide as either eye, the vitta blackish, next the antennæ slightly narrower than either side of front, the latter gray pollinose; frontal bristles descending to base of third antennal joint, three in each row directed backward; two pairs of orbitals; face in profile slightly convex, retreating below, the sides bare; ridges bristly on lower half; antennæ four-fifths as long as the face, black, the base of the third joint yellowish, this joint two and one-half times as long as the second; arista thickened on the basal fourth, its penultimate joint broader than long; proboscis black, palpi yellow. Thorax black, gray pollinose and with four black vittæ; three postsutural and three sternopleural macrochætæ; scutellum grayish black, bearing three long marginal pairs of macrochætæ. Abdomen yellow, base of first segment and a dorsal vitta extending to the third black, the third segment irregularly tinged with blackish; first segment destitute of dorsal macrochætæ, the second with a small discal and marginal pair, the third with a discal pair and marginal row, fourth with a marginal row; venter appearing as if longitudinally incised in the middle, the second and third segments lobately produced, the lobes of the third segment studded with short black spines on their terminal half. Legs black, hind tibiæ rather sparsely ciliate with short bristles, with a longer one at the first fourth and one nearly twice as long at the middle. Wings hyaline, third vein bearing four bristles at its base, the others bare; apical cross vein straight, ending close to the third at last fourth of distance from second to tip of wing; hind cross vein strongly curved. Length 7 mm. Jacksonville, Florida. W. H. Ashmead. A single specimen.

Acemyia dentata n. sp. ♀.

Black, the palpi (usually) and labella of proboscis yellow, face and cheeks tinged with yellow. Front at vertex almost as wide as either eye, the sides yellowish or gray pollinose, the vitta black, next the antennæ slightly narrower than either side of the front; three pairs of forwardly directed orbital bristles; frontal bristles descending nearly to middle of second antennal joint, three in each row curving backward; sides of face bare, each at narrowest part one-sixth as wide as the facial depression; two or three bristles above each vibrissa; cheeks less than one-fifth as wide as the eye-height, bare except on the lower half; antennæ two-thirds as long as the face, the third joint nearly twice as long as the second, the apical front angle produced in the form of a tooth; arista thickened on the basal third. Thorax grayish pollinose, marked with four black vittæ, three postsutural macrochætæ and two sternopleural; scutellum bearing three pairs of long marginal macrochætæ, the posterior pair cruciate. Abdomen gray pollinose and with black reflecting spots, first segment destitute of dorsal macrochætæ, the second with a marginal pair, the third and fourth each with a marginal row. Hind tibia unequally bristly, not ciliate. Wings hyaline, a single bristle at the base of third vein, the others bare; apical crossvein slightly concave, joining the third a short distance before its tip, the bend destitute of a stump or wrinkle; hind cross vein nearly straight. Length 6.5 mm. Georgetown, Florida, May 10, 1894, and Mobile, Alabama, October 22, 1894 (C. W. Johnson); also Los Angeles Co., California, in February and September (D. W. Coquillett). Four specimens.

Belvosia slossonæ n. sp. ♀.

Black, the frontal vitta, face, palpi and scutellum yellow. Front at vertex one and one-half times as wide as either eye, frontal vitta next the antennæ subequal in width to either side of the front, the latter shining yellowish gray; two pairs of orbital bristles; frontal bristles descending almost to tip of second antennal joint, the uppermost in each row curving backward, the next one directed backward and inward, the two outside of these curving backward; anterior pair of ocellar bristles wanting; antennæ four-fifths as long as the face, the third joint slightly over twice as long as the second; arista thickened its entire length, the penultimate joint slightly longer than broad; sides of face bare, at the narrowest part one-third as wide as the median depression; ridges bristly on the lower two-thirds, several yellow bristly hairs outside of them on the lower half of the ridges; cheeks one-third as wide as the eye-height, covered with short yellowish bristles. Thorax grayish pollinose, and with four black vittæ; four postsutural macrochætæ, and four sternopleural; scutellum bearing four pairs of long marginal macrochætæ and a short apical pair. Abdomen on bases of last three segments yellowish gray pollinose, most extended on the third and fourth; first and second segments each bearing a marginal pair of macrochætæ, the third and fourth each with a marginal row. Hind tibiæ rather sparsely ciliate with somewhat long bristles. Wings grayish brown, tinged with yellow along the veins of the basal and costal portions; third vein bearing four bristles at its base, the others bare. Length

11 mm. Charlotte Harbor, Florida. Mrs. A. T. Slosson, to whom this fine species is respectfully dedicated. A single specimen.

Hypostena maculosa n. sp. ♀.

Black, the front angles of the second and third abdominal segments broadly yellow. Front at vertex two-thirds as wide as either eye, vitta brownish, next the antennæ one and one-fourth times as wide as either side of the front, the latter light gray pollinose; two pairs of orbital bristles; frontal bristles descending to base of third antennal joint; antennæ seven-eighths as long as the face, the third joint nearly three times as long as the second, three times as long as wide; arista thickened on the basal third; sides of face bare, each at the narrowest part one-tenth as wide as the median depression, face in profile convex; ridges bare; cheeks one-seventh as wide as the eye-height. Thorax bearing only three postsutural macrochætæ, two sternopleural; scutellum bearing two pairs of long marginal macrochætæ. Abdomen bearing a marginal pair of macrochætæ on each of the first two segments and a marginal row on the third and fourth. Hind tibiæ not ciliate. Wings hyaline, third vein bearing three bristles at the base, the others bare, small cross vein slightly before the middle of the discal cell, hind cross vein midway between the latter and the bend which is rounded, apical cross vein slightly arcuate, ending close to the third at a point less than the length of the small cross vein before the tip of the wing. Length 3.5 mm. St. Augustine, Florida. C. W. Johnson. A single specimen.

Myiobia depile n. sp. ♂.

Front at vertex less than half as wide as either eye, the vitta brownish black, next the antennæ two-thirds as wide as either side of the front, the latter golden pollinose; no orbital bristles; frontal bristles descending to base of second antennal joint, only one in each row directed backward; antennæ four-fifths as long as the face, yellow, the third joint, except at base, black, two and one-half times as long as the second; arista short pilose, thickened on its basal fifth; sides of face and the ridges bare; cheeks slightly over one-fourth as wide as the eye-height, bare except on lower half; palpi yellow; clavate, one-fourth longer than the antennæ; proboscis yellow, in the middle brown, slender, rigid, the portion beyond the basal articulation nearly as long as height of head, labella well developed.

Thorax black, yellowish pollinose, not distinctly black vittæ; three postsutural macrochætæ and three sternopleural; scutellum yellow, bearing two long marginal pairs of macrochætæ. Abdomen shining yellow, a black spot below the hind angles of the third and fourth segments; a dorsal vitta and the apex tinged with reddish; first segment destitute of dorsal macrochætæ, the second with a marginal pair, third and fourth each with a marginal row. Legs yellow, tarsi black, pulvilli as long as the last tarsal joint. Wings yellowish hyaline, third vein bearing about five bristles at the base, the others bare; hind cross vein at two-thirds the distance from the small cross-vein to the bend, which is rounded; costal spine minute.

♀ same as the ♂ with these exceptions: Front three-fourths as wide as either eye, vitta scarcely half as wide as either side of the front, two pairs of orbital bristles, three frontal bristles in each row directed backward, antennæ three-fourths as long as the face, the third joint twice as long as the second, palpi nearly one and one-half times as long as the antennæ, pulvilli scarcely half as long as the last tarsal joint.

Length 6.5 mm. Jacksonville (W. H. Ashmead), and Juniper Creek (C. W. Johnson), Florida; and Ithaca, N. Y. (F. H. Chittenden). One male and three females. One of the latter has a dorsal black spot at the apex of the second and third abdominal segments.

Prosenoides flavipes n. sp. ♀.

Black, the antennæ except at apex, palpi, femora and tibiæ yellow. Front at vertex nearly as broad as either eye, vitta dark [redacted] and three sternopleural; scutellum bearing two pairs of long marginal macrochætæ and a short cruciate apical pair. Abdomen wholly gray pollinose, with light and olive gray reflections; first segment destitute of dorsal macrochætæ, second with a marginal pair, the third and fourth each with a marginal row. Wings hyaline, third vein with a few bristles at base, the others bare; costal spine minute, bend of fourth vein with a rounded angle, apical cross vein nearly straight, apical cell open. Pulvilli less than half as long as the last tarsal joint.

♂ same as the ♀ with the following exceptions: Entire antennæ, sides of first two abdominal segments and front angles of the third, yellow. Front one-third as broad as either eye, no orbital bristles, only one frontal bristle in each row curving backward, antennæ three-fifths as long as the face, the third joint two and one-half times as long as the second.

Length 6 to 7.5 mm. Lake Worth and Charlotte Harbor, Florida, Mrs. A. T. Slosson. One male and three females.

Gymnodexia zonata n. sp. ♀.

Black, the antennæ, anterior portion of the cheeks, palpi, labella, knees and abdomen, yellowish, the latter on sides of first three segments and a dorsal vitta on the same, black. Front at vertex four-fifths as wide as either eye, vitta next the antennæ three-fourths as wide as either side of the front, the latter and the face whitish pollinose; two pairs of orbital bristles; frontal bristles descending almost to insertion of antennæ, three in each row curving backward; sides of face bare; vibrissæ inserted almost on the oral margin, two or three short bristles above each; antennæ six-sevenths as long as the face, the third joint four times as long as the second, arista long plumose; cheeks nearly as broad as the eye-height; proboscis robust, the portion beyond the basal articulation slightly over half as long as height of head. Thorax gray pollinose and marked with four black vittæ; three postsutural and two sternopleural macrochætæ; scutellum bearing three long marginal pairs. Abdomen shining except the bases of the last three segments which are gray pollinose, most extended on the second, where it reaches slightly beyond the middle; first segment destitute of dorsal macrochætæ, second with a marginal pair, third with a marginal row, the fourth with scattered macrochætæ. Wings hyaline, slightly smoky along the costa and bordering the veins; third vein bearing four bristles at the base, the others bare; costal spine minute; calypteres white. Length 9.5 mm. Jacksonville, Florida, May 22, 1894, C. W. Johnson. A single specimen.

SARCOPHAGIDÆ.

JOHNSONIA n. gen.

First, third and fifth veins bristly, hind cross vein perpendicular, at two-fifths the distance from the small cross vein to the bend, the latter rectangular and bearing a long appendage, apical cell short petiolate. Antennæ nearly as long as the face, arista long plumose on the basal three-fifths, the remainder naked ; sides of face bearing short bristly hairs, at narrowest part nearly half as wide as the median depression, the latter not carinate ; ridges bare, straight, diverging below, vibrissæ strong, widely separated, on the oral margin ; cheeks one-sixth as broad as the eye-height, eyes bare ; proboscis much shorter than height of head, labella large, palpi well-developed. Type, the following species :

Johnsonia elegans n. sp. ♀

Head black, gray pollinose; front at vertex slightly wider than either eye ; vitta brownish black, next the antennæ half as wide as either side of the front ; only one pair of orbital bristles ; frontal bristles descending to insertion of antennæ, two in each row curving backward ; antennæ dark brown, more than the basal half of the third joint yellow, this joint twice as long as the second ; longest hairs of arista over twice as long as its greatest diameter ; proboscis

Length 6 mm. St. Augustine, Florida. C. W. Johnson, after whom it gives me pleasure to name this interesting genus. Described from a single specimen.

HELICOBIA n. gen.

First and third veins bristly, the others bare, apical cell open, ending at three-fifths the distance from second vein to the wing-tip; bend of fourth vein rectangular and bearing a long appendage; hind cross-vein much less oblique than the apical, terminating at last third of distance between the small and the bend, its posterior end much nearer the wing-margin than to the small cross vein. Head at the vibrissæ nearly as long as at insertion of antennæ, its lower margin convex; frontal bristles descending to middle of second antennal joint; sides of face each bearing a row of short macrochætæ; antennæ three-fourths as long as the face, the third joint twice as long as the second; arista long plumose on the basal three-fifths, the remainder bare; vibrissæ inserted slightly above the oral margin, a few short bristles above each; cheeks one-third as broad as the eye-height, the eyes bare. Abdomen oval, consisting of four segments, densely gray pollinose. Type: *Sarcophaga helicis* Townsend (Psyche, February, 1892, pages 220, 221). Charlotte Harbor, Florida (Mrs. A. T. Slosson). Mississippi (H. E. Weed). Illinois (Dr. W. A. Nason). District of Columbia and Los Angeles, Cal. (D. W. Coquillett). Ohio (H. A. Surface).

Drosophila maculosa n. sp. ♂.

Head, including the antennæ and mouth parts, yellow, an ocellar dot and transverse pair of spots above the centre of the occiput, black. Thorax, pleura and scutellum opaque yellow, unmarked. Abdomen shining blackish-brown, the first segment, front corners of the second, and a spot near each front corner of the third and fourth, yellow. Legs, including the tarsi, yellowish white. Wings hyaline, marked with four brown spots, one at tips of the first and second veins and one on the small and hind cross veins, that on the small cross vein less than one-fourth as large as either of the others; the costal vein only reaches the apex of the third. Length 3 mm. Charlotte Harbor (Mrs. A. T. Slosson), and Archer, Florida. Two specimens; the one from the latter locality is contained in the National Museum collection.

Drosophila vittata n. sp. ♂.

Head yellowish white, frontal triangle dark yellow, an ocellar dot and spot in center of occiput, black; antennæ and proboscis pale yellow, the palpi black. Thorax and scutellum opaque light grayish yellow, marked with three dark yellow vittæ; pleura brown on nearly the upper half, the remainder yellow; metanotum yellow, a median vitta and the sides brown. Abdomen shining, yellow, gradually passing into dark brown at the tip; a dorsal yellow vitta; hind margin of each segment whitish. Legs, including the coxæ and tarsi, yellow. Wings hyaline; the costal vein reaches the apex of the fourth, first vein ending at first fourth of length of wing, small cross vein before the first third of distance from the branching of the second and third veins to the hind cross vein. Length 1.5 mm. Charlotte Harbor, Florida. Mrs. A. T. Slosson. A single specimen.

Chlorops abdominalis n. sp. ♂.

Head yellow, face and cheeks usually a lighter yellow, an ocellar dot and two large spots on upper part of the occiput, black; frontal triangle at vertex almost in contact with each eye, the sides converging to lower end of front, indications of a longitudinal median sulcus; antennæ reddish yellow, the third joint orbicular, black, except at its base; arista black; clypeus unmarked; proboscis yellow, palpi black. Thorax subshining black, unmarked; pleura reddish yellow, marked with four black spots; scutellum black, convex; metanotum fourth, grayish yellow. Legs black, the knees narrowly yellow. Halteres light yellow. Wings hyaline, third and fourth veins slightly diverging toward their apices. Length 2.4 mm. Welaka, Florida, May 9, 1894; and Delaware County, Pa., July 23, 1893. C. W. Johnson. Two specimens.

LIST OF SPECIES.

BY C. W. JOHNSON.

CECIDOMYIDÆ.

DIPLOSIS sp. On Oak, Georgiana, Jan. 24.

DIPLOSIS sp. Charlotte Harbor (Mrs. Slosson).

MYCETOPHILIDÆ.

PLATYURA ELEGANS Coq. Georgetown, May 9.

NEOGLAPHYROPTERA CINCTA Coq. Tick Island, May 12.

SCIARA sp. (U. S. Nat. Mus.)

BIBIONIDÆ.

BIBIO RUFITHORAX Wied. St. Augustine. The thorax of the ♂ is black.

BIBIO THORACICA Say. East Florida (Say).

DILOPHUS ORBATUS Say. St. Augustine; Juniper Co., May 15; Inverness, Mar. 27 (Robertson); Charlotte Harbor—exceedingly common from February to the end of March (Mrs. Slosson).

PLECIA RUFICOLLIS Fabr. St. Augustine; Charlotte Harbor, Mar. (Mrs. Slosson); Lake Harney (Messrs. Hubbard and Schwarz).

PLECIA sp. St. Augustine; Drayton Island, May 9.

CULICIDÆ.

CULEX TÆNIORHYNCHUS Wied. St. Augustine; Tick Island, Volusia Co., May 12; Charlotte Harbor (Mrs. Slosson).

CULEX CILIATUS, Fabr. St. Augustine.

CULEX FASCIATUS, Fabr. Charlotte Harbor, Mar. (Mrs. Slosson).

ANOPHELES CRUCIANS Wied. Troublesome, Tick Island, May 12.

CHIRONOMIDÆ.

Chironomus niveipennis, Fabr. Charlotte Harbor (Mrs. Slosson).

Chironomus riparius Macq. Charlotte Harbor (Mrs. Slosson).

Chironomus viridis Macq. Charlotte Harbor (Mrs. Slosson).

Chironomus sp. Georgiana (Whitfeld). U. S. Nat. Mus.

Tanypus thoracicus Loew. Tick Island, May 12.

Tanypus scapularis Loew. Tick Island, May 12.

Tanypus concinnus Coq. Tick Island, May 12.

Ceratopogon argentatus Loew. Welaka, May 9.

Ceratopogon albiaria Coq. Drayton Island, May 9.

TIPULIDÆ.

Dicranomyia floridana O. S. Spring of 1858 (Osten Sacken).

Dicranomyia distans O. S. March, 1858 (Osten Sacken).

Rhipidia domestica O. S. Drayton Island, May 10; Ormond (Mrs. Slosson).

Erioptera vespertina O. S.

Gnophomyia luctuosa O. S. March (Osten Sacken); Jacksonville, May 22.

Limnophila luteipennis O. S. March (Osten Sacken).

Limnophila macrocera Say. March (Osten Sacken).

Limnophila sp. (Mrs. Slosson.)

Bittacomorpha clavipes Fabr. March (Osten Sacken).

Tipula costalis Say. Charlotte Harbor, January (Mrs. Slosson).

Tipula filipes Walk. Jacksonville, May 22; Tick Island, May 12; Charlotte Harbor (Mrs. Slosson).

Pachyrrhina ferruginea Fabr. St. Augustine, March; Charlotte Harbor (Mrs. Slosson).

Pachyrrhina nobilis Loew. Jacksonville, May 22.

Pachyrrhina suturalis Loew.

XYLOPHAGIDÆ.

Rhachicerus fulvicollis Haliday. Tick Island, May 12.

STRATIOMYIDÆ.

Sargus decorus Say. St. Augustine, March 15-

Sargus tricolor Loew. St. Augustine; Tick Island, March 15.

Sargus elegans Loew.

Ptecticus sackenii Williston. (Pergande.)

Hermetia illucens Linné. St. Augustine; Fernandina, pupa, March 23, imago issued May 23 (U. S. Nat. Mus.); Lake Worth (Mrs. Slosson).

Hermetia sexmaculata Macq. (Mus. Comp. Zool.)

Odontomyia cincta Oliv. St. Augustine, March 15.

Odontomyia trivittata Say. St. Augustine (F. H. Genung); Astor, May 11; Ormond, April (Mrs. Slosson).

Odontomyia obscura Oliv. St. Augustine; Charlotte Harbor (Mrs. Slosson).

Odontomyia flavicornis Oliv. (U. S. Nat. Mus.)

Stratiomyia senaria Loew. St. Augustine.

Nemotelus acutirostris Loew. St. Augustine (F. H. Genung).

Nemotelus carbonarius Loew. St. Augustine, March; Charlotte Harbor (Mrs. Slosson).

Nemotelus immaculatus Johnson. St. Augustine (F. H. Genung).

Nemotelus slossonæ Johnson. Charlotte Harbor, March (Mrs. Slosson).

TABANIDÆ.

Chrysops atropos O. S. St. Augustine; Crescent City (Hubbard); Eagle Lake (U. S. Nat. Mus.)

Chrysops callidus O. S. St. Augustine.

Chrysops flavidus Wied. St. Augustine; Putnam Co., June (U. S. Nat. Mus.); Georgiana (Whitfeld).

Chrysops morosus O. S. Common St. Augustine, March 15; Georgiana (Whitfeld), July 17.

Chrysops univittatus Macq. (U. S. Nat. Mus.)

Chrysops plangens Wied. (Osten Sacken.)

Chrysops vittatus Wied. Palatka, May 19; Horse Landing, St. John's River, May 17.

Diachlorus ferrugatus, Fabr. St. Augustine; Horse Landing, St. John's River, May 17; Biscayne; Enterprise, May 25 (Schwarz), U. S. Nat. Mus.

Tabanus americanus Forster. St. Augustine; Astor, May 11; Indian River (U. S. Nat. Mus.); Tick Island, May 13; Ormond, April (Mrs. Slosson).

Tabanus atratus Fabr. St. Augustine; Key West, February 7; Ft. Capron, July 9. (U. S. Nat. Mus.)

Tabanus nigrovittatus Macq. St. Augustine.

Tabanus fuscopunctatus Macq. St. Augustine, March; Tick Island, May 12; Georgiana; Sand Point, March 21. (U. S. Nat. Mus.)

Tabanus fronto, O. S. St. Augustine; Charlotte Harbor, March (Mrs. Slosson).

Tabanus lineola Fabr. St. Augustine; Georgiana; Alachua Co. (U. S. Nat. Mus.); Ormond (Mrs. Slosson).

Tabanus wiedemanni O. S. St. Augustine; Ormond (Mrs. Slosson); Enterprise, May 17 (Schwarz & Hubbard).

Tabanus megerlei Wied. St. Augustine; Eagle Lake (U. S. Nat. Mus.); Palatka (Mrs. Slosson).

Tabanus melanocerus Wied. St. Augustine.

Tabanus mexicanus Linn. St. Augustine; Georgetown, May 16; Tick Island, May 13; Indian River (Whitfeld); Ormond (Mrs. Slosson).

Tabanus pumilus Macq. St. Augustine; Ormond (Mrs. Slosson). Enterprise, May 11–13 (Schwarz & Hubbard).

Tabanus rufus Pal.-Beauv. St. Augustine; Tick Island May 12; Lake Harney, May 4 (Schwarz & Hubbard).

Tabanus tener O. S. Ormond (Mrs. Slosson). Indian River (E. Palmer).

Tabanus trijunctus Walker. St. Augustine; Ft. Capron, April 24; Georgiana (Whitfeld). U. S. Nat. Mus.

Tabanus costalis Wied. (Mrs. Slosson). Lake Harney, May 5 (Schwarz & Hubbard).

Tabanus molestus, Say. Tick Island, May 12; Juniper Creek, May 15.

Tabanus giganteus Degeer. (Williston).

Tabanus fur Will. (Williston).

Tabanus proximus Walk. "Probably described from an unrecognizable specimen of some well known species" (Osten Sacken).

Tabanus gracilis Wied. (Williston.)

Tabanus turbidus Wied. = ? T. fusconervosus Macq. Walker records the latter from Florida.

Tabanus pygmæus Will. (Williston).

Tabanus coffeatus Macq. Waldo, June 2 (Messrs. Schwarz & Hubbard).

Tabanus recedens Walker.

TABANUS PSAMMOPHILUS O. S. Lake Worth (Mrs. Slosson). Ft. Capron, April 10 (Messrs. Schwarz & Hubbard).

TABANUS LONGUS O. S. Georgiana (Whitfeld). U. S. Nat. Mus.; Ft. Capron, March 26 (Messrs. Schwarz & Hubbard).

TABANUS STYGIUS, Say. Georgiana, July (Whitfeld). U. S. Nat. Mus.

TABANUS SPARUS Whitney. Inverness, March 18–24 (Robertson).

TABANUS ABDOMINALIS Fabr. St. Augustine.

TABANUS sp. St. Augustine (F. H. Genung).

TABANUS sp. Georgiana (Whitfeld). U. S. Nat. Mus.

HAEMATOPOTA AMERICANA O. S.? Crescent City, June (Hubbard). U. S. Nat. Mus.

LEPTIDÆ.

CHRYSOPILA VELUTINA Loew. St. Augustine, March 15.

CHRYSOPILA BASALARIS Say. St. Augustine, March 15; Charlotte Harbor (Mrs. Slosson).

LEPTIS ALBICORNIS Say. St. Augustine, March 15.

LEPTIS VERTEBRATA Say.

ASILIDÆ.

LEPTOGASTER OBSCURIPENNIS Johnson. St. Augustine.

CERATURGUS CRUCIATUS Say. Ormond, April (Mrs. Slosson).

DIZONIAS TRISTIS Walker. (D. bicincta Loew.) St. Augustine; Georgiana (Whitfeld); Enterprise, May 15. (U. S. Nat. Mus.)

ANISOPOGON SENILIS Bigot. (Morrison). Coquillett.

LAPHYSTIA SEXFASCIATA Say. St. Augustine. Common along the seashore, June, July.

CYRTOPOGON CHRYSOPOGON Loew. (Morrison). Coquillett.

HOLOCEPHALA ABDOMINALIS Say. Common St. Augustine; Juniper Creek, May 15.

HOLOCEPHALA CALVA Loew. Seven specimens. Juniper Creek, May 15.

TARACTICUS OCTOPUNCTATUS Say. (Morrison). Coquillett.

HOLOPOGON PHILADELPHICUS Schin. Ormond, April (Mrs. Slosson).

NICOCLES PICTUS Loew. St. Augustine.

ATOMOSIA PUELLA Wied. Palatka, May 19.

DEROMYIA TERNATUS Loew. St. Augustine.

DEROMYIA BIGOTII Bellardi. St. Augustine; Ormond, June (Mrs Slosson).

DEROMYIA WINTHEMI Wied. (D. misellus Loew.) (U. S. Nat. Mus.)

DEROMYIA sp. (U. S. Nat. Mus.)

DEROMYIA sp. (U. S. Nat. Mus.)

DASYLLIS TERGISSA Say. Tampa, March (Mrs. Slosson).

DASYLLIS POSTICATA Say. Jacksonville, April (Mrs. Slosson).

LAPHRIA SAFFRANA Fabr. St. Augustine; Sand Point, May 3. (U. S. Nat. Mus.) Charlotte Harbor, March, and Pensacola, April (Mrs. Slosson).

LAMPRIA BICOLOR Wied. Ormond (Mrs. Slosson).

PROMACHUS FITCHII O. S. St. Augustine.

ANDRENOSOMA PYRRHACRA Wied. (U. S. Nat. Mus.) Georgiana (Whitfeld); Ormond, June (Mrs. Slosson).

MALLOPHORA BOMBOIDES. St. Augustine.

MALLOPHORA NIGRA Will. St. Augustine.

MALLOPHORA ORCINA Wied. St. Augustine, May 20; Palatka, May 19; Crescent City (Hubbard).

MALLOPHORA LAPHROIDES Wied. St. Augustine (F. H. Genung).

ERAX CINERASCENS Bell. St. Augustine. Lake Worth, on the white sand of the ocean beach (Mrs. Slosson).

ERAX LATERALIS Macq. St. Augustine, May 20; Volusia, May 11 and 14.

ERAX BASTARDI Macq. (U. S. Nat. Mus.)

ERAX sp. St. Augustine.

PROCTACANTHUS HEROS Wied. St. Augustine; Georgiana (Whitfeld) U. S. Nat. Mus.

PROCTACANTHUS BREVIPENNIS Wied. Common St. Augustine; Ormond, Charlotte Harbor and Pensacola (Mrs. Slosson); Cedar Keys, June 7 (U. S. Nat. Mus.)

PROCTACANTHUS FULVIVENTRIS Macq. Georgiana (U. S. Nat. Mus.)

PROCTACANTHUS PHILADELPHICUS Macq. Georgiana (U. S. Nat. Mus.)

ASILUS NOVÆ-SCOTIÆ Macq. Charlotte Harbor (Mrs. Slosson.)

ASILUS AURATUS Johnson. St. Augustine, May 21; Palatka, May 19.

OMMATIUS TIBIALIS Say. St. Augustine, May 21; Georgetown, May 15; Georgiana, July 15 (Whitfeld.)

MIDAIDÆ.

Midas clavatus Drury. St. Augustine; Astor, May 11.

Midas incisus Macq. St. Augustine (♂), Crescent City (Hubbard), U. S. Nat. Mus.

Midas pachygaster Westwood. St. Augustine (♀). This is probably the ♀ of *M. incisus.*

Midas parvulus Westwood. Georgia (Westwood), Florida (Walker).

Midas sp. (U. S. Nat. Museum.)

Midas sp. (U. S. Nat. Museum.)

Midas sp. (U. S. Nat. Museum.)

Midas sp. (U. S. Nat. Museum.)

Dolichogaster brevicornis Wied., var. iopterus (Wied.) O. S. "St. John's Bluff, Doubleday" (Walker.)

NEMESTRINIDÆ.

Rhynchocephalus volaticus Williston. St. Augustine.

Hirmoneura flavipes Williston.

BOMBYLIDÆ.

Exoprosopa eremita O. S. St. Augustine (F. H. Genung); Lake Worth (Mrs. Slosson.)

Exoprosopa fascipennis Say. St. Augustine; Mt. Royal, May 17; Lake Worth (Mrs. Slosson.)

Exoprosopa fasciata Macq. St. Augustine; Ormond, June (Mrs. Slosson.)

Exoprosopa emarginata Macq. Lake Worth (Mrs. Slosson).

Argyramœba analis Say. St. Augustine, May 21.

Argyramœba cephus Fabr. Two specimens, St. Augustine.

Argyramœba simson Fabr. St. Augustine (F. H. Genung.)

Argyramœba limatula Say. Lake Worth (Mrs. Slosson.)

Argyramœba albofasciata Macq. Lake Worth (Mrs. Slosson.)

Argyramœba latilimbata Bigot. St. Augustine.

Argyramœba œdipus Fabr. (U. S. Nat. Mus.); (Mrs. Slosson); Orlando, March 20 (Robertson.)

Argyramœba argyropyga Wied. (U. S. Nat. Mus.)

Anthrax (Dipalta) serpentina O. S; St. Augustine.

Anthrax (Hemipenthes) sinuosa Wied. St. Augustine.

Anthrax (Hemipenthes) morio Linné. Suwannee (Mrs. Slosson.)

LTERNATA Say. (Mrs. Slosson.)

ATERALIS Say. St. Augustine: Inverness, February ch 31 (Robertson.)

GRIPPINA O. S. Suwannee (Mrs. Slosson.)

AUNUS Fabr. St. Augustine.

TEGMINIPENNIS Say. Ormond; Jacksonville, April losson.)

ISPAR Coq. St. Augustine (F. H. Genung.)

ANTHRAX FULVOHIRTA Wied. St. Augustine, May 20; Lake Worth (Mrs. Slosson.)

ANTHRAX CELER Wied. St. Augustine. Syn., *A. floridana* Macq. (Coquillett.)

ANTHRAX LUCIFER Fabr. Suwannee (Mrs. Slosson); Key West (U. S. Nat. Mus.); Inverness, March 2–April 4 (Robertson.)

ANTHRAX MIRA Coq. St. Augustine (F. H. Genung.)

ANTHRAX CEYX Loew. (Syn.? *A. demogorgon* Walker.)

ONCODOCERA LEUCOPROCTA Wied. Suwannee (Mrs. Slosson.)

BOMBYLIUS MEXICANUS Wied. (Mrs. Slosson.)

BOMBYLIUS VARIUS Fabr. (Morrison) Coquillett.

BOMBYLIUS ATRICEPS Loew. Charlotte Harbor (Mrs. Slosson); Inverness, March 10–27 (Robertson.)

BOMBYLIUS LANCIFER O. S. (Morrison) Coquillett.

BOMBYLIUS FRATELLUS Wied. (*B. major* Linné) (U. S. Nat. Mus.)

BOMBYLIUS PYGMAEUS Fabr. (Morrison) Coquillett.

SYSTŒCHUS SOLITUS Walk. St. Augustine, common, May 21; Suwannee, April; Lake Worth (Mrs. Slosson.)

TOXOPHORA AMPHITEA Walker. St. Augustine; Ormond (Mrs. Slosson); Georgiana, July (Whitfeld); Inverness, March 5–26; Orlando, February 17 (Robertson.)

TOXOPHORA FULVA O. S. (U. S. Nat. Mus.)

TOXOPHORA VIRGATA O. S. Inverness, March 22 (Robertson.)

PHTHIRIA PUNCTIPENNIS Walker. St. Augustine.

PHTHIRIA SULPHUREA Loew. St. Augustine (F. H. Genung); Georgetown, May 16; Crescent City (Hubbard.)

SYSTROPUS MACER Loew. (Georgiana (Whitfeld.)

GERON sp. (U. S. Nat. Mus.)

LEPIDOPHORA ÆGERIIFORMIS Westw. Georgiana (Whitfeld) U. S. Nat. Mus.

THEREVIDÆ.

PSILOCEPHALA HÆMORRHOIDALIS Macq. Ormond, April (Mrs. Slosson.)

PSILOCEPHALA FESTINA Coq. St. Augustine, March 15; Drayton Island, May 9; Ormond (Mrs. Slosson); Georgiana, July (Whitfeld.)

PSILOCEPHALA NOTATA Wied. St. Augustine, March 14; Ormond, April (Mrs. Slosson.)

PSILOCEPHALA TERGISSA Say. St. Augustine, March 15; Ormond, April (Mrs. Slosson.)

PSILOCEPHALA JOHNSONI Coq. St. Augustine, March 15; Ormond, April (Mrs. Slosson.)

PSILOCEPHALA OBSCURA Coq. Key West, February 5 (U. S. Nat. Mus.)

PSILOCEPHALA PICTIPENNIS Wied. St. Augustine; Drayton, Island and Welaka, May 9; Crescent City (Hubbard) U. S. Nat. Mus.

PSILOCEPHALA PLACIDA Coq. (U. S. Nat. Mus.)

PSILOCEPHALA MARMORATA Coq. St. Augustine.

PSILOCEPHALA MARCIDA Coq. (U. S. Nat. Mus.)

THEREVA DIVERSA Coq. (U. S. Mat. Mus.)

SCENOPINIDÆ.

SCENOPINUS NUBILIPES Say. (Loew.)

EMPIDÆ.

HYBOS TRIPLEX Walker. Charlotte Harbor, March (Mrs. Slosson.)

EUHYBUS SUBJECTUS Walker. St. Augustine; Charlotte Harbor (Mrs. Slosson.)

SYNECHES SIMPLEX Walker. Charlotte Harbor (Mrs. Slosson.)

SYNECHES PUSILLUS Loew. Charlotte Harbor (Mrs. Slosson.)

HILARA LEUCOPTERA Loew. Charlotte Harbor (Mrs. Slosson.)

HEMERODROMIA SUPERSTITIOSA Say. Drayton Island, May 9.

DOLICHOPODIDÆ.*

DOLICHOPUS LONGIPENNIS Loew. (Aldrich.)

DOLICHOPUS IRRASUS Walker.

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* The new and undetermined species of this family will be described later by Prof. J. M. Aldrich.

Dolichopus laticornis Loew. Lake Worth, March (Mrs. Slosson.)

Dolichopus sp. ♀ St. Augustine (Aldrich, Kan. Univ. Quarterly, II, 8.)

Gymnopternus debilis Loew. (Aldrich.)

Gymnopternus difficilis Loew. St. Augustine.

Paraclinus sp. Lake Worth (Mrs. Slosson.)

Paraclinus sp, Charlotte Harbor (Mrs. Slosson.)

Pelastoneurus cognatus Loew. St. Augustine, March 14.

Pelastoneurus abbreviatus Loew. St. Augustine, March.

Pelastoneurus n. sp. St. Augustine, March 15.

Pelastoneurus sp. St. Augustine; Ormond (Mrs. Slosson.)

Pelastoneurus sp. St. Augustine; Charlotte Harbor (Mrs. Slosson.)

Tachytrechus n. sp. (Aldrich.)

Diostracus sp. St. Augustine, May 21.

Argyra n. sp. (Aldrich.)

Diaphorus mundus Loew. Drayton Island, May 10; Charlotte Harbor (Mrs. Slosson.)

Diaphorus leucostomus Loew. Charlotte Harbor, February (Mrs. Slosson.)

Asyndetus n. sp. Charlotte Harbor (Mrs. Slosson.)

Chrysotus costalis Loew. (Loew.)

Chrysotus sp. Juniper Creek, May 15.

Chrysotus sp. Juniper Creek, May 15.

Psilopus n. sp. Lake Worth (Mrs. Slosson.)

Gnamptopsilopus variegatus Loew. St. Augustine; Welaka, May 9; Palatka, May 19.

Gnamptopsilopus psittacinus Loew. St. Augustine; Lake Worth, January (Mrs. Slosson.)

Dactylomyia gracilipes Aldr.

SYRPHIDÆ.

Microdon pachystylum Will. St. Augustine.

Microdon fulgens Wied. St. Augustine, pupæ found in decayed pine logs; Suwannee (Mrs. Slosson).

Microdon fuscipennis Macq. Georgiana, July 17 (Whitfeld).

Microdon limbus Will. (U. S. Nat. Mus.)

Microdon scitulus Will. (U. S. Nat. Mus.)

Omegasyrphus baliopterus Loew. Charlotte Harbor (Mrs. Slosson).

Omegasyrphus coarctatus Loew. Orlando, March 16 (Robertson).

Paragus tibialis Fallen. St. Augustine, May 21; Palatka, May 19.

Pipiza pulchella Will. St. Augustine, March 15; Lake Worth (Mrs. Slosson).

Psilota baccata Macq. Inverness, Feb. 8–12 (Robertson).

Chrysogaster nitida Wied. St. Augustine; Tick Island, May 12; Orlando, May 16; Inverness, Feb. 14 (Robertson).

Mesogramma politum Say. St. Augustine.

Mesogramma parvula Loew. St. Augustine, May 20.

Mesogramma marginatum Say. St. Augustine, May 2; Orlando, Feb. 21; Inverness, March 9 (Robertson).

Mesogramma boscii Macq. St. Augustine; Charlotte Harbor, Feb. (Mrs. Slosson); Orlando, March 15; Inverness, Feb. 29 (Robertson).

Mesogramma planiventris Loew. St. Augustine, May 20.

Allograpta obliqua Say. Inverness, Feb. 12, March 12 (Robertson).

Xanthogramma emarginata Say.

Syrphus americanus Wied. Lake Worth (Mrs. Slosson); Orlando, Feb. 21; Inverness, Feb. 12 (Robertson).

BACCHA CLAVATA Fabr. St. Augustine, May 21; Lake Worth (Mrs. Slosson); Crescent City (Hubbard); Orlando, Feb. 17 (Robertson).

BACCHA NOTATA Loew. Charlotte Harbor (Mrs. Slosson).

BACCHA TARCHETIUS Walker. Orlando, March 16; Inverness, March 26 (Robertson).

BACCHA LUGENS Loew. Crescent City (Hubbard). U. S. Nat. Mus.

OCYPTAMUS FUSCIPENNIS Say. St. Augustine, March 15, May 20; Palatka and Crescent City (U. S. Nat. Mus.).

VOLUCELLA ESURIANS Fabr. St. Augustine; Georgiana (Whitfeld); Lake Worth and Charlotte Harbor, Feb.–Apr. (Mrs. Slosson); Key West, Feb. 7 (U. S. Nat. Mus.).

VOLUCELLA PALLENS Wied. (*V. sexpunctata* Lw.) St. Augustine, March 15; Georgiana; July (Whitfeld); Lake Worth (U. S. Nat. Mus.); Charlotte Harbor (Mrs. Slosson); Inverness, February 12 (Robertson).

VOLUCELLA PUSILLA Macq. Common, St. Augustine, March 15, May 21; Georgiana, July (Whitfeld).

VOLUCELLA FASCIATA Macq. (Mrs. Slosson), Inverness, February 3, March 24 (Robertson).

VOLUCELLA EUGENIA Will. (Williston.)

VOLUCELLA VESICULOSA Fabr. (Williston). Inverness, March 19 (Robertson).

VOLUCELLA OBESA Fabr. (Osten Sacken.)

ERISTALIS DIMIDIATUS Wied. St. Augustine.

ERISTALIS TRANSVERSUS Wied. St. Augustine, March 15; Inverness, March 14 (Robertson.

ERISTALIS VINETORUM Fabr. St. Augustine; Lake Worth (Mrs. Slosson).

ERISTALIS ALBIFRONS Wied. (*E. albiceps* Macq.) St. Augustine. (F. H. Genung); Orlando, February 21 (Robertson); Lake Worth and Charlotte Harbor (Mrs. Slosson); Georgiana (Whitfeld).

MEROMACRUS CRUCIGERUS Wied. St. Augustine; Juniper Creek, May 15; Charlotte Harbor (Mrs. Slosson).

MALLOTA CIMBICIFORMIS Fall. Inverness, February 12 (Robertson).

HELOPHILUS SIMILIS Macq. St. Augustine; Inverness, February 12 (Robertson).

Helophilus divisus Loew. Orlando, February 22 (Robertson).

Tropidia albistylum Macq. Lake Worth and Charlotte Harbor (Mrs. Slosson); Inverness, February 5 (Robertson).

Xylota ejuncida Say. St. Augustine; Charlotte Harbor, March (Mrs. Slosson).

Xylota pigra Fabr. (Mrs. Slosson); Inverness, February 8, March 25 (Robertson).

Spilomyia hamifera Loew. St. Augustine; Inverness, March 5 (Robertson).

Milesia ornata Fabr. St. Augustine; Jacksonville, May 22; Juniper Creek, May 15; Inverness, March 12, April 5 (Robertson); Ormond (Mrs. Slosson); Georgiana (Whitfeld).

Ceria abbreviata Loew.

Ceria signifera Loew. Inverness, February 12, 14 (Robertson).

CONOPIDÆ.

Conops bulbirostris Loew. St. Augustine.

Conops brachyrhynchus Macq. (*C. obscuripennis* Will.) St. Augustine.

Physocephala excisus Wied. St. Augustine; Crescent City, July 2 (Hubbard); Inverness, March 18 (Robertson); Charlotte Harbor and Pensacola, March and April (Mrs. Slosson).

Physocephala castanoptera Loew. St. Augustine.

Physocephala sagittaria Say. (U. S. Nat. Mus.); Inverness, February 8 (Robertson).

Physocephala tibialis Say. (Morrison) Coquillett.

Zodion fulvifrons Say. Lake Worth and Ormond, March (Mrs. Slosson).

Zodion nanellum Loew. Inverness, February 9 (Robertson).

Dalmania vitiosa Coq. Inverness, March 25 (Robertson).

PIPUNCULIDÆ.

Prothechus lateralis Walk. St. Augustine.

OESTRIDÆ.

Cuterebra buccata Fabr. St. Augustine.

Cuterebra cuniculi Clark? St. Augustine.

TACHINIDÆ.

Trichopoda ciliata Fabr. (*T. pennipes* Fabr. ♂) St. Augustine; Charlotte Harbor (Mrs. Slosson).

Trichopoda formosa Wied. St. Augustine.

Trichopoda lanipes Fabr. St. Augustine.

Trichopoda pyrrhogaster Wied. Georgiana, July (Whitfeld).

Trichopoda histrio Walker. (*T. trifasciata* Loew.) Inverness, March 18 (Robertson).

Xanthomelana atripennis Say. St. Augustine; Inverness, February 11 (Robertson).

Ocyptera euchenor Walker. Inverness, March 18 (Robertson).

Jurinia smaragdina Macq. Lake Worth (Mrs. Slosson); Inverness, February 8, March 22 (Robertson).

Jurinia flavifrons Jænnick. (Mrs. Slosson).

Jurinia hystrix Fabr. Lake Worth (Mrs. Slosson).

Archytas boscii Desv. St. Augustine.

Archytas aterrima Desv. St. Augustine.

Belvosia bifasciata Fabr. St. Augustine.

Belvosia slossonæ Coq. Charlotte Harbor (Mrs. Slosson).

Thysanomyia inermis Bigot. Charlotte Harbor (Mrs. Slosson).

Gonia sp. Inverness, March 9–29 (Robertson).

Miltogramma cinerascens Town. ? Inverness, March 20 (Robertson).

Miltogramma decisa Town. Inverness, March 10–16 (Robertson).

Miltogramma argentifrons Town. Orlando, March 16; Inverness, March 18 (Robertson).

Miltogramma trilineata v. d. Wulp. Inverness, February 16, Clista americana Town. St. Augustine, May 21.

Carcelia leucaniæ Kirk. St. Augustine; Georgetown, May 10.

Œstrophasia clausa B. & B. Ormond (Mrs. Slosson).

Phasiopteryx bilimeki B. & B. Georgiana (U. S. Nat. Mus.).

Pseudochæta argentifrons Coq. Charlotte Harbor (Mrs. Slosson).

Tachina orgyiæ Town. (Mrs. Slosson.)

Tachina melobosis Walk. (Walker.)

Masiphya aurigera Coq. (Mrs. Slosson.)

Clytiomyia punctata Coq. Charlotte Harbor (Mrs. Slosson).

Achætoneura rubentis Coq. Jacksonville (W. H. Ashmead).

Achætoneura armigera Coq. Ormond (Mrs. Slosson.)

Chætoglossa violæ Town. Inverness, February 16 to March 26 (Robertson).

Chætoglossa picticornis Town. Inverness, Febuary 16 to April 4 (Robertson).

Chætoglossa nigripalpis Town. Inverness, February 23 (Robertson).

Acroglossa hesperidarum Will. Inverness, March 10, 22 (Robertson).

Siphona illinoensis Town. Inverness, February 12, March 22 (Robertson).

Phasioclista metallica Town. Orlando, Inverness, March 15–22 (Robertson).

Siphoclytia robertsonii Town. Inverness, March 13–27 (Robertson).

Atrophopoda singularis Town. Inverness, March 1 (Robertson).

Loewia globosa Town. Inverness, March 3–20 (Robertson).

Siphophyto floridensis Town. Inverness, March 1–29 (Robertson).

Tachinophyto floridensis Town. Inverness, March 1–27 (Robertson).

Atrophopalpus angusticornis Town. Inverness, March 3–19 (Robertson).

Pseudomyothyria indecisa Town. Inverness, March 3-to 5 (Robertson).

Myothyria vanderwulpi Town. Inverness, February 12 (Robertson).

PACHYOPHTHALMUS FLORIDENSIS Town. (Robertson).

PACHYOPHTHALMUS TRYPOXYLONIS Town. Ormond (Mrs. Slosson).

TACHINOMYIA FLORIDENSIS Town. St. Augustine.

PTILOCHÆTA sp. (Mrs. Slosson.)

SARCOTACHINELLA INTERMEDIA Town. Charlotte Harbor (Mrs. Slosson).

SPALLANZANIA PANSA Snow. St. Augustine.

DEGEERIA LEUCOCYCLA v. d. Wulp. St. Augustine; Tick Island, May 12.

ACEMYIA DENTATA Coq. Georgetown, May 10.

SARCOMACRONYCHIA FLORIDENSIS Town. Inverness, March 1–19 (Robertson).

HYPOSTENA MACULOSA Coq. St. Augustine.

DEXIDÆ.

GYMNODEXIA TRIANGULARIS v. d. Wulp. Juniper Cr., May 15.

GYMNODEXIA ZONATA Coq. Jacksonville, May 22.

LEPTODA VERTEBRATA Say. Ormond; Tampa (Mrs. Slosson).

EUANTHA DIVES Wied. St. Augustine.

PROSENOIDES FLAVIPES Coq. Lake Worth; Charlotte Harbor (Mrs. Slosson).

MYOBIA DEPILE Coq. Juniper Creek, May 15; Jacksonville (Ashmead).

SARCOPHAGIDÆ.

SARCOPHAGA FULVIPES Walker. St. Augustine.

MUSCIDÆ.

Stomoxys calcitrans Linné. St. Augustine; Lake Worth (Mrs. Slosson).

Calliphora erythrocephala Meig. St. Augustine.

Calliphora viridescens R. Desv. (Walker.)

Musca domestica Linné. St. Augustine; Inverness (Robertson).

Lucilia cæsar Linné. St. Augustine; Ormond, March, April (Mrs. Slosson).

Lucilia cornicina Fabr. St. Augustine; Ormond, March, April (Mrs. Slosson); Orlando, March 15 (Robertson).

Lucilia sericata Meig. Orlando, March 16 (Robertson).

Chrysomyia certima Walker.

Compsomyia macellaria Fabr. St. Augustine; Orlando and Inverness, March 10–16 (Robertson).

Synthesiomyia brasiliana B. & B. In a cave, Citrus Co. (H. G. Hubbard).

ANTHOMYIDÆ.

Ophyra aenescens Wied. St. Augustine, March; Charlotte Harbor (Mrs. Slosson); Volusia and Juniper Creek, May 14, 15.

Leucomelina garrula Giglio-Tos. St. Augustine, March; Inverness, February 29 (Robertson); Charlotte Harbor (Mrs. Slosson).

Limnophora sp. Orlando, March 15 (Robertson).

Homalomyia femorata Loew. St. John's River, May. These were bred in large numbers from the dead fresh water shells after my return home.

Lispe uliginosa Fallen. St. Augustine, March; Georgetown, May 9; Ormond (Mrs. Slosson).

Caricea antica Walk. St. Augustine, March; Drayton Island, May 9; Inverness, February (Robertson).

Caricea solita Walk. St. Augustine, March. Ormond (Mrs. Slosson).

Caricea fuscopunctata Macq. St. Augustine, March; Inverness, February (Robertson); St. John's River, May 17; Charlotte Harbor (Mrs. Slosson).

Caricea nivea Loew. St. Augustine, March; Inverness, February (Robertson).

Cœnosia lata Walk. (Mrs. Slosson).

CŒNOSIA sp. Charlotte Harbor (Mrs. Slosson).

CHORTOPHILA sp. Inverness, February 14 (Robertson).

CHORTOPHILA sp. Inverness, February 12 (Robertson).

PHORBIA FUSCICEPS Zett. St. Augustine; Orlando, March (Robertson).

ANTHOMYIA NARONA Walk.

CORDYLURIDÆ.

CLEIGASTRA CAPILLATA Leow. St. Augustine.

FUCELLIA FUCORUM Fallen. St. Augustine, March; Charlotte Harbor, February (Mrs. Slosson).

SCIOMYZIDÆ.

SCIOMYZA NANA Fallen. St. Augustine; Ormond, January (Mrs. Slosson).

SCIOMYZA HUMILIS Loew. St. Augustine, March 15.

TETANOCERA SPINICORNIS Loew. St. Augustine, March 15; Ormond, January (Mrs. Slosson).

MICROPEZIDÆ.

CALOBATA NEBULOSA Loew. St. Augustine; Juniper Creek, May 15; Charlotte Harbor, February (Mrs. Slosson).

CALOBATA LASCIVA Fabr. St. Augustine, March 15; Juniper Creek, May 15; Jacksonville, April (Mrs. Slosson); Crescent City (Hubbard).

Rivellia quadrifasciata Macq. Volusia and Drayton Island, May; Ormond, March (Mrs. Slosson).

Rivellia n. sp. Drayton Island, May 9.

Stenopterina n. sp. St. Augustine.

Camptoneura picta Fabr. St. Augustine, May 20; Cedar Keys, February 14 (U. S. Nat. Mus.); Lake Worth (Mrs. Slosson).

Tephronota humilis Loew. St. Augustine, March 15; Orlando, March 16 (Robertson).

Acrosticta n. sp. Charlotte Harbor (Mrs. Slosson).

Euxesta notata Wied. Inverness, February 10 (Robertson).

Euxesta quaternaria Loew. Lake Worth, March, on cocoanut palm (Mrs. Slosson).

Euxesta scoriacea Loew. Charlotte Harbor (Mrs. Slosson).

Euxesta nitidiventris Loew. Charlotte Harbor, March (Mrs. Slosson).

Euxesta annonæ Fabr. St. Augustine, March 15.

Chætopsis ænea Wied. St. Augustine.

Chætopsis n. sp. St. Augustine, March; Ormond (Mrs. Slosson).

Gen. nov. n. sp. St. Augustine, March 15.

TRYPETIDÆ.

Acrotoxa? acidusa (Walker) Loew.

Spilographa electa Say.

Aciura insecta Loew. Lake Worth, January (Mrs. Slosson).

Carphotricha culta Wied. St. Augustine, May, on Thistle; Ormond, April (Mrs. Slosson).

Eurosta solidaginis Fitch. Charlotte Harbor, March (Mrs Slosson).

Neaspilota vernoniæ Loew. Inverness, March 19 (Robertson).

Ensina humilis Loew. Key West, January 29 (U. S. Nat. Mus.).

Tephritis fucata Fabr. St. Augustine.

Euaresta bella Loew. Drayton Island, May 9; Tick Island May 12.

Urellia abstersa Loew. Key West, February 3 (U. S. Nat. Mus.).

Urellia solaris Loew. Lake Worth, March (Mrs. Slosson); Inverness, March 9–22 (Robertson).

Urellia mevarna (Walker) Loew. "The specimen in the British Museum seems very like *T. solaris*. *Trypeta narytia* Walker. There are four specimens in the British Museum, two of them are *Chætopsis aenea*, and one of these bears Walker's label 'narytia,' the two other marked 'Florida Doubleday' seem to be *Tephronota humilis*." Osten Sacken.

LONCHÆIDÆ.

Lonchæa glaberrima Wied. Lake Worth (Mrs. Slosson).

SAPROMYZIDÆ.

Sapromyza resinosa Wied. Collected by Mrs. Slosson (Coquillett).

Sapromyza umbrosa Loew. Ormond (Mrs. Slosson).

Pachycerina verticalis Loew. St. Augustine March; Lake Worth, January (Mrs. Slosson); Inverness, March (Robertson).

Lauxania opaca Loew. St. Augustine; Palatka, May 19; Juniper Creek, May 15.

Lauxania trivittata Loew. Georgetown, May 16.

SEPSIDÆ.

Sepsis vicaria Walker. St. Augustine; Inverness, February 10 (Robertson).

PIOPHILIDÆ.

Piophila casei Linné. Charlotte Harbor (Mrs. Slosson).

EPHYDRIDÆ.

Dichæta brevicauda Loew. St. Augustine.

Notiphila sp. Orlando, February 23 (Robertson).

Notiphila sp. Inverness, April 6 (Robertson).

Paralimna appendiculata Loew. St. Augustine.

Psilopa sp. Charlotte Harbor (Mrs. Slosson).

Hydrellia sp. St. Augustine, March.

Ochthera tuberculata Loew. St. Augustine, March.

Ochthera exculpta Loew. St. Augustine; Inverness, March (Robertson).

Brachydeutera dimidiata Loew. Charlotte Harbor (Mrs. Slosson).

Parydra quadrituberculata Loew. Ormond, January (Mrs. Slosson).

Parydra sp. Charlotte Harbor (Mrs. Slosson).

Ephydra subopaca Loew. Charlotte Harbor, February (Mrs. Slosson).

Ephydra nana Walk. Ormond (Mrs. Slosson).

Scatella lugens Loew. Ormond (Mrs. Slosson).

Cænia spinosa Loew. St. Augustine.

GEOMYSIDÆ.

Heterochroa ornata Johnson. Drayton Island, May 9.

DROSOPHILIDÆ.

Drosophila ampelophila Loew. St. Augustine; Ormond; Charlotte Harbor (Mrs. Slosson).

Drosophila quadrimaculata Walk. Charlotte Harbor (Mrs. Slosson).

Drosophila punctulata Loew. St. Augustine, March.

Drosophila maculosa Coq. Charlotte Harbor (Mrs. Slosson).

Drosophila vittata Coq. Charlotte Harbor (Mrs. Slosson).

Drosophila guttifera Walk. (Walker.)

OSCINIDÆ.

Crassiseta formosa Loew. Ormond (Mrs. Slosson).

Crassiseta costata Loew. St. Augustine, March.

Hippelates convexus Loew. St. Augustine, March.

Oscinis, sp. Charlotte Harbor (Mrs. Slosson).

Meromyza americana Fitch. St. Augustine.

Siphonella cinerea Loew. Charlotte Harbor (Mrs. Slosson).

Chlorops pubescens Loew. St. Augustine; Orlando, March 16 (Robertson).

Chlorops grata Loew. St. Augustine.

Chlorops trivialis Loew. St. Augustine.

Chlorops abdominalis Coq. Charlotte Harbor (Mrs. Slosson).

AGROMYZIDÆ.

Lobioptera arcuata Loew. (Robertson); Ormond (Mrs. Slosson).

Lobioptera indecora Loew. (Robertson).

Lobioptera lacteipennis Loew. Charlotte Harbor (Mrs. Slosson).

Leucopis bella Loew. Horse Landing, St. John's River, May 17; Crescent City (Hubbard).

AGROMYZA JUCUNDA v. d. Wulp. Georgetown, May 9.

AGROMYZA SETOSA Loew. Palatka, May 19.

AGROMYZA TERMINALIS Coq. Welaka, May 9.

BORBORIDÆ.

LIMOSINA FONTINALIS Fall. St. Augustine, March.

PHORIDÆ.

PHORA INSCISURALIS Loew. ♀ "Loew described the ♂ the sexes vary in the color of the thorax, which is black dorsally in the ♂ and wholly yellow in the ♀ as in the European *bicolor.*" (Coquillett.) Charlotte Harbor (Mrs. Slosson). Tick Island, May 12.

PHORA FASCIATA Fall. Charlotte Harbor (Mrs. Slosson.)

HIPPOBOSCIDÆ.

OLFERSIA AMERICANA Leach. St. Augustine, on the Screech Owl.

OLFERSIA sp. St. Augustine, on the White Heron, November 8.

OLFERSIA sp. St. Augustine, on the Fish Hawk (F. H. Genung).

OLFERSIA sp. St. Augustine, on the Chuck Will's Widow (F. H. Genung).

OLFERSIA sp. St. Augustine.

NOTES ON AMERICAN ENCHYTRAEIDÆ. I—NEW SPECIES OF FRIDERICIA FROM THE VICINITY OF PHILADELPHIA.

BY J. PERCY MOORE.

Five species of *Fridericia* have been collected in the neighborhood of Philadelphia, of which one is as yet insufficiently studied. Brief descriptions of the remaining four follow:

Fridericia longa n. s.

Length, 25–30 mm. Number of somites, 60–69.

Anterior to the clitellum the setæ number four to the bundle, the inner pair being two-thirds the length of the outer. Posterior to the clitellum the bundles are constituted of a single pair.

The spermathecæ (Plate XIII, figs. 4 and 5), are provided with from five to eight accessory sacs or diverticula. These are much smaller than the central sac, around the base of which they are arranged in a single whorl, and, in the younger worms at least, approximated in pairs. The central or primary sac is more or less cylindrical, with concave, (as in fig. 4) or convex sides, in which latter case it may be nearly spherical. The stalk or duct is slender, and two or three times the length of the expanded portion of the spermatheca; a few small unicellular glands cluster about its mouth.

A pair of simple salivary glands (pepto-nephridia) open into the œsophagus in the fifth somite. In the examples studied they were quite unbranched (Plate XIII, fig. 6).

Supra-œsophageal ganglion two-thirds as broad as long, convex behind.

The nephridia and heart were not studied.

F. longa has been met with in only one locality, where it was exceedingly plentiful during the month of April of this year. This spot is on a very dry bank by a roadside: the surface soil, in which the worms were found, is a thin layer of wood mould with a few scattered leaves which were not sufficient to prevent the ground from baking hard and dry. A later visit (in July) found the worms in very much reduced numbers and of smaller size. In movement and somewhat in form this species recalls the nematodes. It possesses a greater number of somites than is usual in the genus, and reaches a larger size than any other Fridericia yet found in this region. The sides of the somites, and especially the whole surface of the prostomium, are plentifully studded with little rounded glandular knobs.

Fridericia agricola n. s.

This species has a length of 20–25 mm., and the mature worm 65 somites.

The setæ are normally arranged in fascicles of four to the thirtieth somite, posterior to which only two persist. Sometimes the number is respectively five or three owing to the retention of one seta of the larger outer pair for a greater length of time than its fellow. This occurs most frequently in the ventral bundles, and in the outer half of a bundle. The setæ of the lateral bundles average about one-tenth longer than those of the ventral. In normal bundles the setæ of the inner pair have a length of nearly two-thirds the outer.

The spermathecæ (Plate XIII, figs. 1, 2 and 3) are quite different from those of *F. longa.* The long, slender stalks are from six to seven times the length of the sacculated portion, and the whole organ proportionately much larger than in the other species herein described. The enlarged portion consists of a central thick-walled cylindrical region, capped by a thinner-walled, more or less conical piece, which at its apex opens into the œsophageal lumen. A single pair of accessory sacs arise opposite to each other from the base of the thick-

The terminal duct passes forward nearly to the septum and then bends sharply backward to its external pore.

Prominent transverse slit-like dorsal pores begin on the somite VII.

These worms are slow and sluggish in movement, and rest most of the time coiled up more or less tightly. They are very plentiful in early spring about the lawns and meadows at Wayne, Delaware County, Pennsylvania, where they are found most frequently coiled up among the bulbous underground stems of garlic. Later during the summer they become very scarce, apparently dying off, as almost none could be found on digging to a depth of eighteen inches, and they did not reappear even when the ground was soaked by prolonged rains.

A variety of this species has the terminal portion of the spermatheca for a short distance from the mouth glandularly thickened, and one or two solid outgrowths alternating with the accessory sacs (Plate XIII, Fig. 3.)

Fridericia parva n. s.

This is the smallest species that I have found. Its length is 12–15 mm., and the number of somites 46.

Four setae constitute a bundle as far as the twenty-fifth somite, behind which there are only two.

The spermathecæ (Plate XIII, fig. 10) are simple, the stalk being about four times the length of the sacs, with glandular aggregations at its base. There are no diverticula to the saccular region, which is broadly pyriform, and attached to the stalk by its broad end, the narrow end opening into the œsophagus.

Salivary glands (Plate XIII, fig. 9) simple and unbranched, with a bulbous dilatation at the mouth.

The dorsal vessel arises from the peri-enteric sinus in somite XVII.

The supra-œsophageal ganglion is oblong ovate, about three-fifths as broad as long, with its greatest width a little posterior to the middle of its length, and the posterior border very slightly emarginated. Ante-septal portion of nephridia about as long as principal part of post-septal (minus the terminal duct) and about one-half as thick.

Funnel of vas deferens broadly ovoidal, with a constricted mouth; duct much coiled and about 9–10 times the length of the funnel. Prostate gland flattened globoid.

The dorsal pores begin on somite VII, and are placed in each succeeding somite one-third of its length from the anterior end.

The larger peritoneal corpuscles are elliptical, with a few small oil drops of very regular size confined to a single circle close to the periphery.

F. parva is opaline white in color, and the prostomium is conspicuously roughened with rounded glandular nodules.

This species is rather common between fallen leaves in damp spots in the woods. July.

Fridericia alba n. s.

Length, 15–22 mm. Number of somites, 56–58.

Setæ usually four per bundle, with the exception of two or three terminal somites, which have two. In certain of the ante-clitellar somites five, six, or even seven, setæ are sometimes present. The setæ of the inner pair in a bundle of four are about three-fourths, or over, the length of the outer. All setæ are rather long and slender.

The spermathecæ (Plate XIII, fig. 11) are almost exactly like those of the last species, the sac being simple, but rather more spherical, the stalk about four to five times its length, and without glands at its mouth.

The salivary glands (Plate XIII, fig. 8) are very slightly branched, with only two or three branches, and may possibly be sometimes simple.

The dorsal vessel arises in the twenty-second somite. The brain is nearly oblong and slightly emarginate behind. Dorsal pores begin

DESCRIPTION OF PLATE XIII.

All figures are magnified 112 diameters.

Figs. 1–3. Spermathecæ of *Fridericia agricola;* 1, in optical section, showing at *s* a bundle of spermatozoa projecting into the oesophageal lumen; 2, a view of the base of the saccular region, and 3, the entire organ of a specimen of the variety mentioned in the text.

Figs. 4 and 5. Spermathecæ of two individuals of *F. longa* in lateral and basal views.

Fig. 6. Salivary gland of *F. longa.*
Fig. 7. " " " *F. agricola.*
Fig. 8. " " " *F. alba.*
Fig. 9. " " " *F. parva.*
Fig. 10. Spermatheca of *F. parva.*
Fig. 11. " " *F. alba.*

AUGUST 6.

MR. CHARLES MORRIS in the Chair.

Nine persons present.

AUGUST 13.

MR. CHARLES MORRIS in the Chair.

Eight persons present.

A paper entitled "On the Status of the Names Aplysia and Tethys," by H. A. Pilsbry, was presented for publication.

AUGUST 20.

MR. C. FEW SEISS in the Chair.

Seven persons present.

A paper entitled "Synopsis of the Bembicini of Boreal America," by William J. Fox, was presented for publication.

AUGUST 27.

ADOLPH W. MILLER, M. D., in the Chair.

Fourteen persons present.

Papers under the following titles were presented for publication:—

"Contributions to the Zoology of Tennessee. No. 1. Reptiles and Amphibians," by Samuel N. Rhoads.

"Preliminary Note on a New Alkali Mineral," by Warren M. Foote.

Dr. Charles W. Burr was elected a member.

The following were ordered to be printed:—

ON THE STATUS OF THE NAMES APLYSIA AND TETHYS.

BY HENRY A. PILSBRY.

In the course of my studies on the "Sea Hares," preliminary to the preparation of a monograph of this group of Tectibranch Mollusks for the Manual of Conchology, my attention was early forced to the fact that in Linnæus' Tenth Edition of the Systema Naturæ the genus *Tethys* was proposed for the animal now known as *Aplysia*, and included nothing else. Moreover, by the terms of the generic diagnosis, such creatures as that known as *Tethys* in modern times are excluded.

In the Twelfth Edition of the Systema, *Tethys* is given a completely different meaning; and the new term *Aplysia* (*Laplysia*) is brought forward to include the species of the earlier *Tethys*. This later usage has been accepted by zoologists until the present day.

The question then arises, shall we apply to Linnæus himself the canons of nomenclature which would be rigorously enforced were the claims of his successors in question? It is with a view to obtaining the opinions of those who are expert in these matters that we present below a full synopsis of the literature bearing upon the questions at issue.

The facts in this case have doubtless been fully unearthed by many investigators; but probably believing it best to "let sleeping dogs rest" no one[1] has to my knowledge seriously raised the questions to which I desire now to direct attention.

The genus *Tethys* was founded by Linné in the tenth edition of the Systema Naturæ, p. 653, for two species, thus:

"254. TETHYS. *Corpus* oblongum, bilabiarum: corpusculo medio cartilagineo oblongo. *Tentacula* duo, cuneiforma. *Foramina* duo, spirantia.

" limacina 1. T. auriculis quatuor.

Habitat in Oceano Australi.

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[1] Except R. Bergh, who in Mal. Unters. I, p. 33, in Semper's Reisen, 2ter Theil, has made the bald statement that Linnæus' earlier *Tethys* was an *Aplysia*, but who continues to use *Tethys* for the Nudibranch.

Corpus oblongum, anticе quasi 4 auriculis acutis in
" leporina. 2. T. corpore rubro, margine membran
duobus.

[a] *Rond. pisc.* 1. *p.* 520. Lepus marinus.

[b] *Bell. aquat.* 437. Lepus marinus.

[c] *Gesn. aquat.* 475. Lepus marinus. *Aldr.*
Lepus marinus 1.

Habitat in M. Mediterraneo.

Conf. Columu. aqu. t. 26, *f.* 2, 3."

It will be noticed that the above description of *lim*
nothing diagnostic of a species, though the genus is cle
As Linné gives us no reference to earlier writers, we h
no means of learning what *Tethys limacina* is, and th
dropped.

In the case of *leporina,* Linné gives ample refe
sources whence his information was derived. There
follows: [a] Gulielmi Rondeletii, etc., Libri de Pi
etc. (1554), Liber xvii. p. 520, figures an *Aplysia* whi
the *A. fasciata* of authors (for it lacks the conspicuou
of *depilans,* and the broadly united parapodia of *pun*
Nature & diversité des poissons, avec leurs pourtrai
au plus pres du naturel, par Pierre Belon du Mans
p. 437, seems to be an undeterminable species of " I
from the Cyclades, known to Belon through the ancient
[c] Conradi Gesneri medici Tigurini Historiæ Ani

ICINI OF BOREAL AMERICA.

AM J. FOX.

ae may be separated as follows:—
y arcuate.
al palpi four-jointed. Middle seg-
mpressed laterally; last ventral seg-
mandibles dentate
. . . . . . BEMBIDULA Burm.
ial palpi two-jointed; metathorax
pressed laterally; last ventral seg-
mandibles dentate . BEMBEX Fabr.
al palpi one-jointed; metathorax
n *Bembex;* mandibles not den-
. . . . MICROBEMBEX Patt.
iform.
lpi four-jointed: anterior ocel-
ort . . . . . MONEDULA Latr.
al palpi one-jointed; anterior
ille long, reaching the hind
. . . . . STENIOLIA Say.

: *Microbembex* as a genus,
respective three-and one-
as much as that genus

V, p. 288, 1789.
i, p. 122, 1874.
1887.

. . . . 2
ings smoky) . . *fodiens*.
ongly marked pygidial
ings scarcely smoky 3
ongly marked pygidial
. . . . 4
he lateral ridge present.
. . . . 5
e of ridges . . 6

Tentacula quatuor, anterius sita.

"depilans. 1. LAPLYSIA.

Syst. Nat. 10. p. 653. Tethys limacina.

Rond. pisc. 1. p. 520. Lepus marinus.

Gesn. aquat. 475. Lepus marinus Rondeletii.

Bohads. mar. 3. *t.* 1, 2, 3. Lernea *graphice.*

Seb. mus. 3. *t.* 1, *f.* 8, 9.

Habitat in M. Mediterraneo; *sanie depilans tactu.*

(B. 51.) *foetidissima ad nauseam usque.*"

The description of the genus is implied for the species *depilans*, and it is also said to be the *Tethys limacina* of the Tenth Edition.[1] The second reference is to the same figure of Rondelet formerly cited for *Tethys leporina.* The third reference repeats the earlier citation to Gesner, with the same mistake as to the page. The fourth reference is to the excellent figure of Bohadsch's *Lernea*, representing unmistakably the *Aplysia depilans* of authors. The reference to Seba is less happy, the figures being too ambiguous for certain determination. It is perfectly evident that Linnæus' generic characters of *Laplysia* were derived from Bohadsch's work; and as the best figures are from the same source, the traditional identification of *depilans* is fully sustained.

SUMMARY.—From the foregoing facts it would appear that (1) the generic name *Tethys* Linn. 1758, must replace *Aplysia* and *Laplysia* Linn. 1767. And (2) as a substitute for *Tethys* Linn. 1767 not 1758, we will probably be compelled to adopt either one of the

SYNOPSIS OF THE BEMBICINI OF BOREAL AMERICA.

BY WILLIAM J. FOX.

The genera composing this Tribe may be separated as follows:—

Anterior ocellus linear, transversely arcuate.
  Maxillary palpi six-jointed, labial palpi four-jointed. Middle segment excavated posteriorly, compressed laterally; last ventral segment (♂) with three spines; mandibles dentate . . . . BEMBIDULA Burm.
  Maxillary palpi four-jointed, labial palpi two-jointed; metathorax flat or convex behind, not compressed laterally; last ventral segment (♂) with a single spine; mandibles dentate . BEMBEX Fabr.
  Maxillary palpi, three-jointed, labial palpi one-jointed; metathorax and last ventral segment (♂) as in *Bembex*; mandibles not dentate . . . . MICROBEMBEX Patt.
Anterior ocellus elliptic, round or reniform.
  Maxillary palpi six-jointed, labial palpi four-jointed; anterior ocellus round or reniform; maxillæ short . . . . . MONEDULA Latr.
  Maxillary palpi three-jointed, labial palpi one-jointed; anterior ocellus longitudinally elliptic; maxillæ long, reaching the hind coxæ . . . . STENIOLIA Say.

In the above table I have considered *Microbembex* as a genus, notwithstanding my former views. In the respective three-and one-jointed palpi it differs from *Bembex* about as much as that genus does from *Monedula*.

BEMBIDULA Burm.

Bembex Olivier (in pt.), Encycl. méthod., IV, p. 288, 1789.
Bembidula Burmeister, Bol. Acad. Cordova. I, p. 122, 1874.
Monedula Cresson (in pt.), Synopsis, p. 116, 1887.

FEMALES.

Posterior coxæ unarmed 2
Posterior coxæ strongly dentate beneath (wings smoky) . . *fodiens*.
2. Last dorsal abdominal segment without a strongly marked pygidial area, the lateral ridge feeble, if present; wings scarcely smoky . 3
Last dorsal abdominal segment with a strongly marked pygidial area, the lateral ridges strong 4
3. Last dorsal segment of abdomen with the lateral ridge present, but weak and short 5
Last dorsal segment of abdomen without any trace of ridges . . 6

4. Legs ferruginous ; wings tolerably smoky ; abdominal marks not very broad and widely separated internally ; mesopleuræ black . . . . *capnoptera.*

   Legs yellow ; wings scarcely smoky ; abdominal marks broad, forming bands; mesopleuræ more or less yellow . . . . . *parata.*

5. Two lines on dorsulum, scutellum anteriorly, metanotum (postscutellum), curved line on middle-segment above, and a broad line on each side of all the dorsal abdominal segments, yellowish ; hind tibiæ striped with black above ; wings clear . . *variegata.*

   The dorsulum, scutellum, metanotum, and middle segment (except latero-posterior angles) black, in rare cases only are these parts spotted, and then only in a slight degree ; fifth and sixth dorsal abdominal segments black, the former sometimes spotted in which case the spots are widely separated ; hind tibiæ not striped with black ; wings dusky, paler at base and apex . . . *quadrifasciata.*

6. Legs, antennæ in part, labrum and tip of abdomen ferruginous ; clypeus yellow . . . . *insidiatrix.*

   Legs black and yellow, the tibiæ in part and the tarsi ferruginous ; antennæ, labrum and the tip of abdomen not at all ferruginous ; clypeus black entirely, or with the base more or less whitish . . . . *ventralis.*

MALES.

1. Posterior coxæ unarmed 2

   "Posterior coxæ armed with a tooth beneath." . . . . . *fodiens.*

2. Intermediate femora beneath at the base drawn out into a prominent tooth 3

   Intermediate femora not dentate beneath at base, at the most angular 5

3. Joints seven to ten of antennæ strongly rounded out beneath . . 4

nal segments, yellowish; hind tibiæ striped with black above; wings clear . . . . *variegata*.

Clypeus (rarely maculated), dorsulum, scutellum, metanotum and middle-segment (except latero-posterior angles) black, in rare cases only are these parts spotted, and then only to a slight degree; last two or three dorsal abdominal segments black, sometimes the fifth, or fifth and sixth spotted, in which case the spots are widely separated; hind tarsi not striped with black, wings a little dusky, paler at base and apex . . . . *quadrifasciata*.

1. **Bembidula variegata Oliv.**

Bembex variegata Olivier, Encycl. Méthod., IV, p. 292.
Monedula dissecta Dahlbom, Hym. Eur., I. p. 186.
Monedula sericea Spinola (in pt.), Gay's Hist. Chile, VI, p. 315.
Bembidula variegata Handlirsh, Sitz., Akad. Wissen, Wien, Math.-naturw. Classe, XCVIII, Abth. 1, p. 488.

Lower California; Albuquerque, New Mexico (Coll. Ashmead); found also in Brazil.

2. **Bembidula quadrifasciata** Say.

Monedula 4-fasciata Say, Exped. St. Peter's River, II, p. 338. ♂ ♀
Monedula Sallei, Guérin, Icon. du Règne Anim., III, 437.
Bembidula quadrifasciata Handlirsch, l. c., p. 492.

Occurs from Pennsylvania to Florida, westward to Texas.

3. **Bembidula insidiatrix** Hdl.

?*Monedula ventralis* Cresson (in pt.), Tr. Am. Ent. Soc., IV, p. 220.
Bembidula insidiatrix Handlirsch, l. c., p. 494. ♀ ♂

Texas and Kentucky (Handlirsch). I have received a ♀ from the Rev. G. Birkman, of Lee County, Texas. The ♂ I have not seen. Handlirsch is probably right in assuming that Cresson confused *ventralis*, *insidiatrix* and *capnoptera*, in his "Hymenoptera Texana."

4. **Bembidula parata** Prov.

Monedula parata Provancher, Add. Hym. Quebec, p. 416.

California (Provancher): Los Angeles (Coquillett); Utah; Nevada. The maculation of this species is a much richer yellow than in *ventralis*, and the ♀, which has been heretofore unnoticed, is very much like the ♂, and has a well developed pygidium.

5. **Bembidula ventralis** Say.

Monedula ventralis Say, l. c., p 338. ♂.
Monedula ventralis Cresson (in. pt.), l. c., p. 220.
Monedula ventralis Provancher, Faun. Ent Can., p. 629. ♀ ♂.
Bembidula ventralis Handlirsch, l. c., p. 495.

Our most abundant and widely distributed species. It is reported from Canada (Provancher), and I have before me specimens from Massachusetts, New Jersey, Pennsylvania, Virginia, Georgia, Texas, Colorado, California, Oregon and other localities.

6. **Bembidula capnoptera** Hdl.

? *Monedula ventralis* Cresson (in pt.), l. c., p. 220.
Bembidula capnoptera Handlirsch, l. c., p. 497, Pl. II, f. 7, 12. ♀ ♂.

Georgia, Kentucky and Texas (Handlirsch). Specimens in collection from Georgia and Texas. The Rev. G. Birkman has sent specimens from Lee county, Texas.

7. **Bembidula fodiens** Hdl.

Bembidula fodiens Handlirsch, l. c., p. 497. Pl. II, f. 14. ♂ ♀.

Georgia and Texas (Handlirsch): Lee county (Birkman). I have not seen the ♂.

BEMBEX Fabr.

Bembex Fabricius, Syst. Ent., p. 361, 1775.
Bembex Olivier, Ency. méthod., IV, p. 288, 1789.
Bembex Handlirsch, Sitzb. Akad. Wissen., Wien, Math.-naturw. Classe, CII, Abth. I, p. 659, 1893.

FEMALES.

Labrum basally with a distinct transverse impression; sixth dorsal segment coarsely wrinkled longitudinally 2
Labrum not impressed basally; sixth dorsal segment more or less punctured, rarely wrinkled 3
2. Mandibles, tubercles and fore part of second dorsal segment not yellow . . . . *Belfragei.*
Mandibles medially, spot on tubercles and anterior portion of second dorsal segment, yellow . . . . *insignis.*
3. Wings distinctly infuscated medially 4
Wings clear throughout 5
4. Greater part of pro- and mesopleuræ and sides of middle segment, clypeus entirely, sides of dorsulum, scutellum and metanotum in part and semicircular line on upper surface of middle segment, [redacted] yellow; markings of abdomen dorsally, broad, all united [redacted] the greater portion of dorsal surface; [redacted] *nubilipennis.* [redacted]

7. Thorax entirely black, including the sides; abdominal spots small, widely separated, the fifth and sixth segments not spotted. . . . . *cinerea.*
   Thorax more or less yellow on the sides 8
8. Mesopleuræ spotted 9
   Mesopleuræ not spotted . . . . *Spinolæ.*
9. Clypeus entirely yellow; form elongate 10
   Clypeus with two black spots basally; form shorter and more robust . . . . *texana.*
10. Markings of abdomen narrow, separated within; mesopleuræ with two small spots. . . . . *amoena.*
   Markings of abdomen broad, united within; mesopleuræ with a large spot covering about half its area. . . . . *connexus.*
11. Thorax at the most clothed with a thin, pale pubescence, more or less yellow on the sides 12
   Thorax densely pruinose, not spotted on sides; markings of abdomen broad, united internally, greenish-white . . *pruinosa.*
12. Dorsulum and abdomen densely clothed with pale pubescence, that on abdomen shortest . . . . *troglodytes.*
   Dorsulum clothed with pubescence on anterior portion only, that on abdomen not dense, but rather indistinct. . . . . . *similans.*
13. Clypeus with two black spots basally . . . . *texana*[1]
   Clypeus entirely yellowish 14
14. Yellow on dorsulam forming a U, as in *Monedula formosa;* sixth dorsal segment somewhat wrinkled . . . . *U-scripta.*
   Yellow on dorsulum, if present, in the shape of short, parallel lines or spots; sixth dorsal segment punctured 15
15. Markings of ventral abdominal segments forming broad, non-interrupted bands; eyes strongly diverging beneath. . . . . *occidentalis.*
   Markings of ventral abdominal segments small, widely interrupted, or connected by a narrow apical line 16
16. Thorax densely pruinose, not spotted on the sides; markings of of abdomen broad, united internally, greenish white . *pruinosa.*
   Thorax at the most clothed with a thin, pale pubescence, more or less yellow on the sides. 17
17. Fore coxæ and greater part of sides of thorax, black, ... *troglodytes.*
   Fore coxæ and greater part of sides of thorax, yellow . . . . *Sayi.*[2]

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[1] This form of *texana*, having the middle segment maculated above is unknown to me.

[2] According to Handirsch's description, the dorsulum of *troglodytes* is spotted medially. The specimens before me do not show this character, differing in that respect from *Sayi*, which has two central and a posterior yellow spot.

MALES.

Labrum basally with a distinct, transverse impression 2
Labrum not impressed basally 3
2. Clypeus entirely or in greater part black; sixth dorsal segment spotted . . . . *Belfragei.*
Clypeus entirely yellow; sixth dorsal segment rarely spotted. . . . . *insignis*
3. Intermediate tarsi short, not longer than their tibiæ; thorax entirely black; dorsal segments 1–3 with a small lateral spot only. . . . . *cinerea.*
Intermediate tarsi longer than their tibiæ; thorax more or less yellow; abdomen usually with prominent maculations 4
4. Seventh ventral segment apically produced into a spine (intermediate tibiæ not serrate) 5
Seventh ventral segment otherwise formed 6
5. Markings bright yellow, those on ventral segments of abdomen broad, continuous; spine of seventh ventral segment pointed at apex . . . . *occidentalis.*
Markings greenish-white those on ventral abdominal segments broad at the sides only, connected by a narrow apical line; spine of seventh ventral segment bifurcate at apex . . . . . *pruinosa.*
6. Antennal joints not dentate or spinose beneath 7
Antennal joints more or less dentate or spinose 8
7. Intermediate femora serrate beneath; middle-segment never yellow above; mesopleuræ with a small yellowish spot; abdomen tolerably hairy . . . . *texana.*
Intermediate femora unarmed; middle-segment usually with a semicircular yellow line above, and the mesopleuræ generally with a large spot; abdomen very hairy . . . . *troglodytes.*

12. Thorax rather densely clothed with long cinereous pubescence; femora about equally black and yellow; markings of abdomen usually greenish-white or pale yellow . . . . *Spinolæ*.
    Thorax not densely clothed with pubescence; femora entirely yellow, more rarely black at extreme base; markings bright yellow (markings of thorax variable) . . . . *nubilipennis*.
13. Flagellum entirely black; form large and robust . . *nubilipennis*.
    Flagellum pale beneath; form smaller and less robust; stipes of genitalia as in fig. 1, Plate XIV . . . . *similans*.

1. **Bembex amœna** Hdl.

Bembex amœna Handlirsch, Sitz. Akad. Wien., Math.-naturw. Classe, Abth. I, CII, p. 769. ♂ ♀, Pl. I, f. 32; Pl. VI, f. 31.

Illinois (Handlirsch); Colorado; British Columbia (Handlirsch); California; Nevada; Utah and Lower California.

This species is the *lucæ* of Cresson, which was never described. The abdominal markings are extremely variable, in some specimens being almost entirely wanting.

2. **Bembex Belfragei** Cress.

Bembex Belfragei Cresson, (in pt.), Pr. Am. Ent. Soc., IV, p. 220, ♂.
Bembex Cressonis Handlirsch, l. c., p. 792, ♂ ♀, Pl. V, f. 6.

Texas. Cresson confused two species in his description of this species and Handlirsch, unable to decide from it which form should be called *Belfragei*, gives them both a new name. I have Cresson's types before me and find that the specimen on the original label to be *Cressonis* Handlirsch. Judging from this and from the fact that all the *Cressonis* are from Texas, while on the contrary the other form is from Georgia and Florida, I would place *Cressonis* as a synonym of *Belfragei*. There is, of course some doubt whether this is the proper course to pursue in the matter, but I think the facts cited above are sufficent to justify this action.

3. **Bembex insignis** Hdl.

Bembex Belfragei Cresson (in pt.), l. c., p. 220. ♂.
Bembex insignis Handlirsch, l. c., p. 793, ♂ ♀, Pl. II, f. 7; Pl. VI, f. 32.

Georgia, Florida (C. W. Johnson).

4. **Bembex Spinolæ** St. Farg.

? *Bembex fasciata* Fabricius, Syst. Piez., 224, 1804.
Bembex Spinolæ Lepeletier, de St. Fargeau, Hym., III, 277.
Bembex fasciata Dahlbom, Hym. Eur., I, 487, ♀.
Bembex Spinolæ Handlirsch, l. c., p. 825.

Occurs throughout the United States and has been known to American students as *fasciata* Fabr., but as Handlirsch points out Fabricius' description applies equally well to other species of the genus and therefore it is impossible to identify the true *fasciata*, without comparison with the type. Cresson's *texana* fits Fabricius' description as well as does *Spinolæ*. As I have pointed out elsewhere, it would have been better to have retained our common species, for years known to American students as *fasciata*, as that species than to have changed it at so late a date. This, of course, is only a matter of opinion, and some day the name will be set right, provided the type of Fabricius' species is in existence; otherwise we will have another name to add to the list of unidentified species.

The amount of yellow on the prothorax varies in *Spinolæ*. I have seen no ♂'s (in a series of specimens) having the stipes of genitalia as figured by Handlirsch. While the form varies, as is stated by that author, it is, as a rule, but little different from that shown in fig. 2, Plate XIV. The description of *fasciata* Fabr., is as follows:

"*B. clypeus integro*, abdomine atro fasciis glaucis lunatis. Hab. in Carolina, Mus. Dom. Bosc.

Summa affinitas *B. rostratæ*. Antennæ nigræ, primo articulo subtus flavo. Caput nigrum, cinereo villosum, clypeo conico, flavo, integro. Thorax niger, cinereo tomentosus margine antico tenuissime, puncto sub alis alioque pone alas glaucis. Abdomen atrum segmento primo fascia interrupta, reliquis fascia e lunulis duabus connatis glaucis. Pedes flavi femoribus basi nigris."

5. **Bembex similans** n. sp. Plate XIV, f. 1.

♀.—Black; head, thorax, dorsulum and scutellum excepted, and more strongly punctured; wings hyaline, nervures pale testaceous. Length 14 mm.

♂.—Colored and marked as in the ♀; joints 5–8 of flagellum dentate beneath; medial femora serrate beneath; second ventral segment carinated down the middle, the sixth armed with a strong tooth; stipes of genitalia as in fig. 1, Pl. XIV. Length 14 mm.

Las Cruces, New Mexico (Cockerell) August 14. Resembles *Spinolæ* but differs in the thoracic markings, not hairy dorsulum, etc.

6. Bembex Sayi Cress. Plate XIV, f. 4.

Bembex Sayi Cresson, Proc. Ent. Soc., Phila. IV, p. 467, ♀; Handlirsch, l c., p. 877.

Colorado; Kansas (Snow); Cypress Mills, Texas (Ashmead); Illinois. Resembles *texana* but differs by having the dorsulum and middle-segment above maculated and by clearer wings. The ♂ is as follows: ♂.— Inner and posterior orbits, clypeus, labrum, spot between antennæ, and another before the anterior ocellus, scape beneath, mandibles except apex, prothorax particularly on the sides, large irregular spot on mesopleuræ and another on the metapleuræ and sides of middle-segment, two short parallel spots on dorsulum anteriorly, a line at the sides near the tegulæ, sometimes a lateral spot on the scutellum, spot on fore and medial coxæ, femora except at base and a line on hind pair, tibiæ except a line on anterior pair, tarsi except claws, two spots, widely separated on first dorsal segment, broader spots, narrowly separated and sometimes each including a black spot on second, strongly sinuated, narrowly separated marks on segments 3-6, spot on seventh, large lateral spots on second ventral sometimes united into a band, and smaller spots on the remaining segments, yellow; flagellum yellowish testaceous beneath; head, thorax, and abdomen with cinereous pubescence, short and rather sparse on abdomen; wings hyaline, nervures pale testaceous; joints 6-8, or 9, of flagellum dentate beneath; middle femora beneath serrate; middle segment strongly impressed down the middle; second ventral segment with a large, strongly curved tooth or hook; sixth ventral with a strong tooth; stipes of genitalia as in fig. 4, Pl. XIV. Length, 13 mm. The three males before me have no yellow on the upper surface of middle segment and a female from the same locality has but a slight trace of yellow on the part mentioned.

7. **Bembex texana** Cress.

Bembex texana Cresson, Trans. Amer. Ent. Soc., IV, p. 219, ♀
Bembex texana Handlirsch, l. c., p. 730, Pl. II, f. 30, Pl. VII, f. 21, ♀ ♂

Texas; Georgia; Florida; Carolina and Kentucky (Handlirsch).

8. **Bembex troglodytes** Hdl.

Bembex troglodytes Handlirsch, l. c., p. 829, Pl. II, f. 29, ♀ ♂

Mexico (Handlirsch); Texas; Jacksonville, Florida (Ashmead). The ♂ of this species resembles that of the *Sayi* to some extent, but abdomen is more hairy and the antennæ not dentate. In his description of this species Handlirsch states that the antennæ are not dentate, while in the synoptic table at the end of his work they are stated to be just the contrary.

9. **Bembex connexus** n. sp. Plate XIV, f. 3.

♀.—Black; head and thorax with cinereous pubescence, that on dorsulum short; with exception of the first dorsal segment the abdomen is almost naked, being very sparsely clothed with a short pubescence; inner and posterior orbits, spot between antennæ and another before the anterior ocellus, clypeus, labrum, mandibles except apex, scape and flagellum beneath, sides of prothorax, large spot on mesopleuræ anteriorly, metapleuræ, greater part of sides of middle segment, tegulæ more or less, spot on fore and medial coxæ, femora except a line above, tibiæ except small spot within on anteriors, tarsi except claws, large spots on first segment, interrupted internally, broad bands or segments 2-5, whose anterior margin is strongly sinuated, that on segment 5 slightly interrupted medially, on apical portion; stipes of genitalia as in fig. 3, Plate XIV. Length 16 mm.

Utah. Its large size, thoracic markings, and broad markings of abdomen serve to distinguish this species. The stipes of the ♂ genitalia is different from that of the other species.

10. **Bembex cinerea** Hdl.

Bembex cinerea Handlirsch, l. c. p. 837, Pl. II, f. 34, Pl. III, f. 29, ♀ ♂.

I have only seen this species from Georgia, the type locality. When viewed from above the males appear to have the abdomen entirely black, but when held a little on the side the small lateral spots are seen.

11. **Bembex nubilipennis** Cress.

Bembex nubilipennis Cresson, Trans. Am. Ent. Soc. IV, p. 218, ♂ ♀; Handlirsch, l. c., Pl. II, f, 38, Pl. VII, f. 25.

Texas; Louisiana; Illinois, and Missouri (Handlirsch); Kansas; Nebraska; Colorado.

10. **Bembex pruinosa** n. sp. Plate XIV, f. 6.

♀.—Black, the head, thorax and first segment of abdomen densely clothed with a pale grayish pubescence, the abdomen with a thin, appressed pubescence; inner and posterior orbits, spot between antennæ, scape and flagellum beneath, clypeus, labrum, mandibles except apex, narrow line on pro- and metanotum, line on hind margin of scutellum, sometimes wanting or represented by a lateral spot only, curved line on upper surface, and a spot on sides of middle segment, either of which or both may be absent, sides of prothorax, in part, rarely, femora except heavy line above and sometimes the base beneath, tibiæ entirely or with a dark spot internally, and tarsi yellowish; dorsal segments 1-5 of abdomen with a broad, uninterrupted band, and a spot at each side of ventrals 2-5, greenish-white; wings hyaline; eyes diverging beneath. Length 17-18 mm.

♂.—Similar in coloration to the ♀, except that the last dorsal segment is spotted; joints 6 and 7 of flagellum slightly dentate; medial femora not serrate, entire; second ventral segment not dentate or tuberculate, the seventh with two short, somewhat parallel carinæ, eighth produced into a bifurcated spine at apex; stipes of genitalia as in fig. 6, Plate XIV. Length 17-18 mm.

Oregon; Kansas; Texas; Camden county, New Jersey (July 22). This is easily distinguished by its markings and male characters.

13. Bembex occidentalis Fox.

Bembex occidentalis Fox, Proc. Cal. Acad. Sci. (2), IV, p, 10, ♀ ♂ ; Handlirsch, l. c., p. 868, pl. III, f. 13; pl. VII. f. 38.

Lower California ; California, Nevada, Las Cruces, New Mexico (Cockerell). The ventral abdominal segments in this species are broadly banded with yellow.

14. Bembex U-scripta n. sp. Plate XIV , f. 5, 9.

♀. Black ; head and thorax clothed with a tolerably dense, long, yellowish pubescence ; abdomen with a short, sparse pubescence ; inner and posterior orbits broadly, spot between antennæ, scape and flagellum beneath, clypeus except a large central spot, labrum mandibles except apex, prothorax, meso-and metapleuræ and sides of middle-segment entirely, large U-shaped mark and lateral line on dorsulum, line on scutellum and metanotum, curved line on middle-segment, posterior face of the latter toward the sides, all the coxæ more or less, femora except a stripe above, tibiæ except an internal spot tarsi, two large sinuated spots on dorsal segments 1–4, almost united within, three spots on segment 5, segment 6, and all the ventral abdominal segments more or less, the spots on segments 3–5 smallest, yellow; wings hyaline, nervures and stigma dark testaceous; eyes diverging a little beneath ; second ventral segment finely and closely punctured throughout ; first transverso-cubital nervure but slightly bent. Length 18 mm.

♂.—Colored and marked like the ♀ except that the front of the head, thorax except above, legs and the first four ventral abdominal

MICROBEMBEX Patton.

Microbembex Patton, Bull. U. S. Geol. Survey, V, 364, 1879.
Bembex (in pt.) Handlirsch, l. c. p. 660, 1893: Fox, Proc. A. N. S. Phila. 1894, p. 303.

Microbembex monodonta Say.

Bembex monodonta Say, Exp. St. Peter's River, Appendix, p. 335.
Bembex ciliata Lepeletier de St. Fargeau, Hym., III, 279, ♂.
Bembex argentifrons Cresson, Proc. Ent. Soc., Phila., IV, p. 141, ♀ ♂.
Microbembex monodonta Patton, l. c., p. 364.
Bembex monodonta Handlirsch, l. c., p. 882.

Occurs throughout the United States and extends to Guatemala. In the ♂ the markings of the abdomen are extremely variable; and I have a specimen before me in which the abdomen is entirely yellow.

MONEDULA Latreille.

Monedula Latreille, Hist. Nat. des Insects, III, 345. 1802.
Stictia Illiger, Faun. Etrusca, Ed. 2, 285, 1806.
Monedula Handlirsch, Sitz. d. k. Akad. Wissensch. Wien. Math.-naturw. Classe, XCIX, Abth. I, 77. 1890.

FEMALES.

Second ventral abdominal segment a little prominent and truncate basally; anterior ocellus round, not placed in a pit 2

Second ventral abdominal segment not prominent, flat; anterior ocellus reniform, placed in a strong pit 3

2. Sides of thorax almost entirely, four longitudinal stripes on dorsulum, line on scutellum and metanotum and a curved one on middle segment, yellowish; femora yellow with a dark stripe above . . . . *signata.*

Sides of thorax except tubercles and lateral angles of middle segment, black; dorsulum with a yellow spot near the tegulæ only, the scutellum with a small lateral spot; middle segment with or without a curved yellow line . . . . *carolina.*

3. Dorsulum with a U-shaped yellow mark (pulvilli large and distinct) 4

Dorsulum at the most with two longitudinal yellow marks . . . 5

4. Length 16–22 mm.; eyes converging above; abdomen about equally yellow and black . . . . *speciosa.*

Length 10 mm.; eyes not converging above; abdomen almost entirely yellow . . . . *scitula.*

5. Pulvilli large and distinct 6

Pulvilli small, indistinct 10

6. Head small, narrower than thorax (head and thorax more hairy than usual; no marks on dorsulum or mesopleuræ; markings pale yellow . . . . *emarginata.*

Head as usual, as wide as thorax 7

7. Anterior wings reaching beyond the third abdominal segment . 8
Anterior wings not reaching beyond the third abdominal segment 9

8. Thorax on sides and beneath almost entirely yellow, the greater part of abdomen of that color; median and hind tarsi as usual; thorax not much narrowed posteriorly. Length 18 mm. . . . . *tenuicornis.*
Thorax on sides and beneath more or less black; the segments of abdomen about equally yellow and black; median and hind tarsi somewhat flattened, the last joint larger than usual; thorax distinctly narrowed posteriorly. Length 11–12 mm. . . . . *pulla.*

9. Length 12–15 mm.; mesosternum in greater part black; front and vertex clothed with long, pale grayish hair; punctuation of dorsulum very dense, almost granular; fasciæ of abdomen deeply emarginate anteriorly . . . . *pictifrons.*
Length 9 mm.; mesosternum almost entirely yellow; front and vertex with sparse, rather short, pale hair; punctuation of dorsulum distinct; fasciæ of abdomen, the first excepted, scarcely emarginate . . . . *exigua.*

10. No yellow on dorsulum medially or on middle segment; first dorsal abdominal segment with a lateral spot, the fasciæ on the following segments interrupted medially; wings fusco-hyaline. . . . . *serrata.*
Dorsulum medially and middle segment above spotted; all the dorsal abdominal segments (except the last in one species) with a continuous fascia; wings hyaline 11

11. Clypeus entirely and a large spot on mesopleuræ as well as greater part of femora, the tibiæ and tarsi entirely and a fascia on all the ventral segments and apex of last dorsal, yellow.

3. First joint of medial tarsi curved 4
First joint of medial tarsi not curved 12

4. Medial femora serrate or carinate beneath, or broadly emarginate 5
Medial femora smooth beneath 11

5. Eighth ventral, with a discal spine 6
Eighth ventral, without a discal spine 8

6. Apical joint of fore tarsi greatly enlarged ; fore femora flattened (second ventral segment unarmed) . . . . *speciosa.*
Apical joint of fore tarsi not enlarged ; fore femora not flattened 7

7. "Second ventral segment flat and unarmed ; pulvilli scarcely discernible." . . . . *serrata.*
Second ventral segment with two approximate tubercles near posterior margin ; pulvilli distinct . . . . *emarginata.*[*]

8. Second ventral segment tuberculate 9
Second ventral flat, not tuberculate (mesopleuræ and middle-segment not at all yellow) . . . . *plana.*

9. Intermediate and posterior femora broadly emarginate or strongly incurved (second ventral segment bituberculate ; pulvilli distinct) . . . . *femorata.*
Intermediate and hind femorara not emarginate or incurved . 10

10. Second ventral segment with two small tubercles ; femora above black at base only ; pulvilli small, indistinct . . . *pulchella.*
Second ventral segment with a single large tubercle; femora above with a black stripe ; pulvilli distinct . . . . . . *tuberculata.*

11. Second ventral segment flat, not tuberculate ; antennæ as usual, not long. Length, 12–13 mm. . . . . *pictifrons.*
Second ventral segment with two large acute tubercles ; antennæ unusually long and slender. Length 18 mm. . . . *tenuicornis.*

12. Fore legs with the tarsal comb but feebly developed ; second ventral segment bituberculate 13
Fore legs with an extremely long and distinct tarsal comb ; second ventral segment flat, not tuberculate ; front narrow . . . *pulla.*

13. Head and thorax rather densely clothed with long hair ; dorsulum with two central yellow spots . . . . *villosa.*
Head and thorax not densely pubescent, sparsely so ; dorsulum without central yellow spots . . . . *usitata.*

1. **Monedula signata** Linné.

Vespa signata Linné, Systema Nat., Ed. X, Vol. I, p. 574.
Bembex signata Fabricius, Syst. Ent., p. 361.
Apis vespiformis De Geer, Mémoires, III, p. 570, Pl. 28, f. 3.
Bembex vespiformis Olivier, Encycl. Méth., IV, p. 290, Pl. 108, f. 18.
Vespa diadema Christ. Naturg. d. Ins., p. 223, Pl. 19, f. 7.
Monedula signata Lepeletier de St. Fargeau, Hym. III, p. 283.

This is the commonest tropical species and is recorded from Mexico and the West Indies as far south as the Argentine Republic. I have a specimen before me, the property of the U. S. National Museum, from Napa County, California, collected by D. W. Coquillett.

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[*] *M. mamillata* Handl., which I have not seen, may be identical with *emarginata.*

2. **Monedula carolina** Fabr.

Bembex carolina Fabricius, Ent. Syst., II, p. 249.
Monedula carolina Latreille, Hist. Nat., XIII, Pl. 102, f. 3.

Occurs from Pennsylvania and New Jersey to Florida and Texas; Illinois.

3. **Monedula speciosa** Cress.

Monedula speciosa Cresson, Proc. Ent. Soc., Philadelphia, IV, p. 470, ♀.
Monedula formosa Cresson, Trans. Am. Ent. Soc., IV, p. 221, ♂ ♀.
Monedula speciosa Patton, Bull. U. S. Geol. Survey, V, p. 361.

Colorado; Kansas; Texas.

4. **Monedula serrata** Hdl.

Monedula serrata Handlirsch, Sitzb. Akad. Wissen, Wien, Math.-naturw. Classe, Abth. I, XCIX, p. 143, ♂.

Georgia. I have not seen the ♂, the sex described by Handlirsch, but a ♀ specimen before me evidently belongs to this species. It agrees with the description of the ♂, except of course lacking the ♂ sexual characters, and the base of clypeus is black. This latter character may vary, however.

5. **Monedula pulchella** Cress.

Monedula pulchella Cresson, Proc. Ent. Soc., Phila., IV, p. 471, ♂ ♀.
Monedula minutula Handlirsch, l. c., p. 148, ♀.

a band, bright yellow; head and thorax more hirsute than in *pulchella;* wings hyaline, nearly twice the length of thorax. Antennæ black, the scape and following three or four joints beneath, yellow, apical joints of flagellum somewhat curved, particularly the last; eyes, if anything, diverging above; dorsulum and scutellum closely and confluently punctured, the middle segment above and behind somewhat more coarsely; last joint of fore tarsi broadly dilated; pulvilli small, though discernible; medial femora serrate beneath; first joint of medial tarsi strongly curved, and within near base with four stout spines; second ventral segment with a single, large, prominence, which is hirsute; sixth and seventh segments somewhat carinated down the middle; eighth ventral without a discal spine; last dorsal shaped as in fig. 8, Plate XIV. Length 14 mm.

Nevada. Easily distinguished by the armature of second ventral and shape of last dorsal segment.

7. **Monedula plana** n. sp. Plate XIV, f. 7.

♂.—Black; inner and posterior orbits, spot before anterior ocellus, inferior portion of front, clypeus, labrum mandibles except apex, scape and following two joints beneath, narrow line on pronotum, tubercles, spot on each side of scutellum, metanotum, legs, the coxæ, trochanters, and femora variegated with black, however, spot on each side of first dorsal segment, a band on the following dorsals except the last which is spotted, that on segment 2 broadest and all emarginate anteriorly in the middle, the second most deeply, and a spot on each side of ventral segment 2, yellowish; flagellum pale testaceous beneath; head and thorax sparsely hirsute; wings hyaline, less than twice longer than the thorax. Apical antennal joints more or less curved but not as strongly as in *tuberculata;* eyes, if anything diverging above; dorsulum and scutellum coriaceous, subtilely and indistinctly punctured, the middle segment more strongly; last joint of fore tarsi not broadly dilated; pulvilli indistinct; medial femora strongly serrate beneath; first joint of medial tarsi curved, with several strong spines within near the base; second ventral segment flat, unarmed; sixth and seventh not armed; eighth without a discal spine; last dorsal as in fig. 7, Plate XIV. Length, 14 mm.

Custer, South Dakota (Aldrich).

8. **Monedula emarginata** Cress.

Monedula emarginata Cresson, Proc. Ent. Soc., Phila., IV, p. 468, ♂ ♀

Colorado. The head in this species is small, narrower than the thorax, while in the other species it is usually somewhat broader than the thorax. In the ♂ the medial femora has a sharp carina beneath, which is sometimes more or less serrate.

9. **Monedula femorata** n. sp. Plate XIV, fig. 10.

♂.—Black; inner and posterior orbits, spot before anterior ocellus, inferior portion of the front, clypeus, labrum, mandibles except apex, scape in front, line on pronotum, tubercles, small spot near tegulæ on dorsulum, lateral spot on scutellum, metanotum, irregular spot on mesopleuræ extending on the sternum, postero-lateral angles of middle-segment, legs, the coxæ, trochanters and femora variegated with black, however, a fascia, narrowly interrupted, on dorsal abdominal segments 1-6, the seventh at apex, and a fascia on ventrals 1-6, yellowish; flagellum, except basal joints which are yellowish testaceous beneath, above black, wings hyaline, not more than one-third longer than the thorax. Eyes diverging a little above; dorsulum, scutellum and base of middle segment with even, distinct punctures, those beyond base of middle segment coarser; pulvilli distinct; medial and hind femora strongly emarginate beneath (see fig.) particularly the former; first joint of medial tarsi curved, much broader than usual, not spinose basally; second ventral abdominal segment bituberculate. Length, 12 mm.

Jacksonville, Florida (coll. Ashmead).

dorsulum, line on scutellum, metanotum and on middle-segment above, legs except a small spot on trochanters and a short line on femora, a broad band on dorsal segments of abdomen 1-5 that on first segment strongly emarginate anteriorly in the middle, those on second and third enclosing two approximate black spots, those on fourth and fifth with four emarginations anteriorly, the posterior margin of all these bands is more or less sinuate, sixth segment yellow apically, ventrals 1-3 entirely and 4-6 with a band, bright yellow; head and thorax with short, pale pubescence; wings hyaline, not twice the length of the thorax. Eyes slightly converging above; dorsulum with shallow, confluent punctures, those of the middle segment coarser. Length, 18 mm.

♂.—Colored like the ♀, but has a greater extent of black on trochanters and femora and thorax, only a lateral spot on dorsulum, the scutellum with two spots, the marks of abdomen separated internally on dorsals 1–6, and those on 1–3 broken into four spots the outer of which are the larger. Antennæ long, setaceous, much longer than in any of the other species, the apical joints, especially the last somewhat curved; apical joint of fore tarsi not broadly dilated; pulvilli distinct; intermediate femora smooth beneath; first joint of intermediate tarsi curved, but not spinose within near the base; second ventral segment with two approximate, elongate tubercles near posterior margin; eighth ventral with a discal spine; last dorsal emarginate at apex. Length 17 mm.

San Bernardino County, California (Coquillett). Both specimens belong to the U. S. National Museum. The species is remarkable for the long antennæ of the male.

12. Monedula scitula n. sp.

♀.— Entirely yellow except as follows: a transverse black stripe above and beneath the ocelli; three longitudinal stripes on dorsulum, the inner of which broadest, largest apically (the dorsulum may be described as having a U-shaped, yellow spot), a dark stripe on scutellum anteriorly, one on the middle segment anteriorly and in the middle, and a dark spot anteriorly in the middle on the first and second dorsal abdominal segments, the size of which is variable, that on the second segment being most transverse; antennæ (except scape) testaceous above; wings hyaline, long, reaching beyond apex of abdomen; head and thorax with tolerably sparse, pale hair. Inner eye margins almost parallel; dorsulum and scutellum rather strongly punctured, the punctures separated; punctuation of middle segment closer and confluent; pulvilli large and distinct. Length 10 mm.

Tucson, Arizona (coll. Ashmead). Three specimens, two of which lack heads. The coloration, size and length of wings will distinguish this species. In shape it reminds one of the bee-genus *Epeolus*, being short and robust.

13. Monedula exigua n. sp.

♀.—Black; inner and posterior orbits, that on the latter extending across the vertex, semicircular spot before anterior ocellus, inferior portion of front, clypeus, labrum, mandibles except apex, scape entirely, the following three or four joints beneath, line on pronotum, sides of prothorax more or less, tubercles, a lateral line and two medial longitudino-parallel lines on dorsulum, irregular spot posteriorly on same, line on scutellum posteriorly, broadest at sides, line on metanotum, another on middle segment, mesopleuræ and sternum almost entirely, spot on metapleuræ, another larger one at postero-lateral angles of middle segment, legs, except spot above on coxæ, trochanters and base of femora, a broad band on dorsal abdominal segments 1–5, the first deeply emarginate anteriorly in middle, the others much less deeply, but more broadly, last segment apically, and all the ventrals more or less, the third entirely, the second nearly so, bright yellow; head and thorax sparsely pubescent, wings hyaline, very short, not one-third longer than thorax; flagellum testaceous above. Eyes slightly diverging above; vertex with the depressions less marked than usual; dorsulum and scutellum rather closely, though distinctly punctured, the middle segment more strongly; pulvilli distinct. Length 9 mm.

Montana.

14. Monedula villosa n. sp.

Monedula mamillata Fox (non Handlirsch), Proc. Calif. Acad. Sci. (2) IV, p. 10.

♂.—Head and thorax with very dense and shaggy, pale pubescence; first dorsal and ventrals 1 and 2 with similar but sparser pubescence, the remaining abdominal segments with short semi-erect pubescence. Black; inner and posterior orbits, spot on each side of fore ocellus, clypeus, labrum, mandibles except apex, scape beneath, line on pronotum, sides of prothorax in part, tubercles, two spots, diverging posteriorly on dorsulum and another near tegulæ, lateral spot on scutellum, line on metanotum, spot on mesopleuræ, attenuated beneath and extending in the form of a narrow line on the anterior part of the mesosternum, then extending down the medial furrow to the medial coxæ, spot on metapleuræ and sides of middle segment, legs except spot on coxæ and trochanters, a stripe above on femora and an internal spot on fore and medial tibiæ, a band on dorsal segments 1-5, narrow medially and greatly expanded at sides, last segment except a narrow, longitudinal, central line, and the ventrals entirely, yellow; flagellum black, testaceous beneath, the first joint yellow basally; wings hyaline, about twice the length of the thorax. Inner eye-margins parallel; apical antennal joints not curved; dorsulum and scutellum rather strongly punctured, the middle segment more coarsely; first joint of fore tarsi a little dilated, but not so much as in *speciosa* and *tuberculata;* pulvilli distinct; medial femora not serrate or dentate beneath; first joint of medial tarsi not at all curved; second ventral segment with two rather large, approximate tubercles near posterior margin, seventh apparently smooth; eighth with a discal spine. Length 11 mm.

Lower Purissima, Lower California (Chas. D. Haines), April, 1889. This is the species doubtfully referred by me to *mamillata* Hdl., in my first paper on Lower California Hymenoptera. There are besides the specimen before me, two others in the collection of the California Academy of Sciences.

15. Monedula usitata n. sp.

♀.—Black; inner and posterior orbits, inferior portion of front, spot before anterior ocellus, clypeus except basal half, labrum, mandibles except apex, scape and following two joints beneath, line on pronotum, tubercles in part, two small longitudinal central spots and a line near tegulæ on dorsulum, lateral spots on scutellum almost united internally, line on pronotum and a curved one sometimes interrupted on middle segment, postero-lateral angles of middle segment and sometimes a spot on sides, femora except apically and tibiæ except within and a facia on dorsal abdominal segments 1-5, yellowish, the fasciæ on first three segments broadest and deeply emarginate anteriorly in the middle, the others sinuated, second ventral sometimes with a small lateral spot; last dorsal entirely black; antennæ dark testaceous above; head and thorax very sparsely hirsute, the latter almost nude; wings subhyaline about twice the length of thorax. Inner eye-margins almost parallel; thorax and scutellum coriaceous, indistinctly punctured, the middle segment distinctly though not very strongly so; pulvilli indistinct. Length 12 mm.

♂.—Similar to ♀ but slenderer and differing in the following points as to coloration: clypeus except narrow anterior margin, black; front rarely spotted before the anterior ocellus; the first five or six joints of flagellum yellowish beneath; yellow of the orbits less prominent; no central spots on dorsulum and no line on middle segment; a narrow yellow spot on the mesopleuræ; the coxæ and trochanters are more or less yellow, the tarsi entirely so; all the ventral segments are fasciated, and the last dorsal has an apical spot. Apical antennal joints not curved; dorsulum and scutellum strongly and closely punctured, the middle segment a little more strongly; pulvilli large and distinct; medial femora smooth beneath; first joint of medial tarsi not at all curved; second ventral segment with two approximate tubercles near posterior margin; seventh smooth; eighth with a discal spine. Length 10-12 mm.

Montana; Nevada; Southern California (O. B. Johnson and D. W. Coquillett). Resembles very much the ♀ of *Bembex monodonta.*

16. Monedula pulla Hdl.

Monedula pulla Handlirsch, l. c., p. 149, ♀.

Southern California (O. B. Johnson and D. W. Coquillett). Whereas *usitata* resembles the ♀ of *Bembex monodonta*, this

STENIOLIA Say.

Steniolia Say, Boston Journ. Nat. Hist., I, p. 366. 1837.
Monedula Cresson (in pt.), Proc. Ent. Soc., Phila., IV, p. 469. 1865.
Steniolia Patton, Bull. U. S. Geol. Survey, V, p. 364. 1879.

FEMALES.

Middle tibiæ dilated 2
Middle tibiæ not dilated (markings luteous) . . . . . *duplicata.*
2. Markings of body whitish . . . . *obliqua.*
" Markings of body luteous." . . . . *tibialis.*

MALES.

Tibia and first joint of tarsi of medial legs not dilated (markings luteous) . . . . *duplicata.*
Tibia and first joint of tarsi of medial legs distinctly dilated . . . 2
3. Markings of body whitish as is also the pubescence of dorsulum and vertex . . . . *obliqua.*
Markings of body luteous, the pubescence of dorsulum and vertex brownish . . . . *tibialis.*

1. **Steniolia duplicata** Prov.
Steniolia duplicata Provancher, Add. Hym. Quebec, p. 414, ♀ ♂.
Steniolia scolopacea Handlirsch, Sitzb. Akad. Wissen., Wien., Math.-naturw. Classe, Bd. XCVIII, Abth. 1, p. 510, ♀ ♂.
Steniolia duplicata Fox, Entom. News, II, p. 195.

This is, perhaps, our commonest and most variable species. New Mexico (Cockerell); Nevada; Utah; California; Oregon; and Lower California. The spots on the dorsulum may be absent, or enlarged, the curved line on upper surface of middle often broken into spots, or absent entirely; there is frequently a small spot on dorsulum just anterior to the scutellum and the extent of black on femora is variable. The markings of the abdomen are tolerably constant, but are subject to some variation and the flagellum varies by having the basal joint beneath only, or all the joints yellowish.

From Lower California are three males and one female which are on the whole larger than usual and the eyes slightly though distinctly converge to the top; otherwise they agree exactly with *scolopacea.* They may represent a distinct species.

2. **Steniolia obliqua** Cress.
Monedula obliqua Cresson, Proc. Ent. Soc., Phila., IV, p. 469, ♀.
Steniolia obliqua Cresson, Synopsis, p. 278; Handlirsch, l. c,, p. 511, Pl. I, f. 16, ♂ ♀.

Colorado; British Columbia (Handlirsch).

3. Steniolia tibialis Hdl.
Steniolia tibialis Handlirsch, l. c., p. 513, Pl. II, f. 1, ♂ ♀.

Nevada; California (Handlirsch). I have not seen the female, but three males from Nevada are before me.

EXPLANATION OF PLATE XIV.

Fig. 1. Stipes of Genitalia, *Bembex similans*, ♂.
" 2. " " " *Bembex Spinolæ*, ♂.
" 3. " " " *Bembex connexus*, ♂.
" 4. " " " *Bembex Sayi*, ♂.
" 5. " " " *Bembex U-scripta*, ♂.
" 6. " " " *Bembex pruinosa*, ♂.
" 7. Last dorsal segment, *Monedula plana*, ♂.
" 8. " " " *Monedula tuberculata*, ♂.
" 9. Intermediate femora, *Bembex U-scripta*, ♂.
" 10. " " *Monedula femorata*, ♂.

SEPTEMBER 3.

MR. CHARLES MORRIS in the Chair.

Sixteen persons present.

Papers under the following titles were presented for publication:—

"Description of a new Genus and Species of Cottoid Fishes from Puget Sound," by Edwin Chapin Starks.

"New Species of Fungi from various localities," by J. B. Ellis and B. M. Everhart.

SEPTEMBER 10.

GEORGE H. HORN, M.D., in the Chair.

Thirteen persons present.

SEPTEMBER 17.

MR. CHARLES MORRIS in the Chair.

Twenty-three persons present.

SEPTEMBER 24.

MR. CHARLES MORRIS in the Chair.

Twenty-one persons present.

A paper entitled "Contributions to the Zoology of Tennessee, No. 2, Birds," by S. N. Rhoads, was presented for publication.

The following were ordered to be printed:—

CONTRIBUTIONS TO THE ZOOLOGY OF TENNESSEE.
No. 1, REPTILES AND AMPHIBIANS.

BY SAMUEL N. RHOADS.

The following is the first of a series of papers treating of the collections of Mammals, Birds, Reptiles and Mollusks made for the Academy of Natural Sciences of Philadelphia by the writer during a trip through Tennessee, in the months of May and June, 1895.

Entering the northwestern corner of the State April 29th, collecting was carried on at the following stations in order of sequence.

1. Samburg (Wheeling), Obion County; April 30th to May 6th, a small village on the eastern shore of Reelfoot Lake, at the mouth of Indian Creek. This region lies at the foot of the Mississippi Bluff, which makes its nearest approach to the lake at this point, the strip of intervening land on which the village is built being about a quarter of a mile wide. The bluff is precipitous, rising more than 100 feet above the lake in this vicinity, and clothed with fine forests of beech, oak and chestnut, the first largely predominating.

It covers a region which, prior to the earthquakes of 1811–12, was a heavily timbered swamp traversed by Reelfoot Creek which flowed south into the Mississippi, and was interspersed with numerous ponds and bayous. Owing to the convulsions at that period this tract was submerged, partly by the subsidence of the swamp, partly by the filling up of the outlet of the creek, and thousands of acres of forested land were permanently flooded from one to ten feet in depth. The original vigor of this splendid growth is still evidenced by the innumerable stumps and blasted tree trunks which stand in and out of the water in every direction and which render the navigation and fishing of these waters so vexatious to a novice, and combine to make the most weird and impressive bit of scenery to be found along the Mississippi Valley. In such an environment we are not surprised to find animal life abounding in a remarkable degree.

Collecting at Samburg was confined to the immediate vicinity, but observations and records were made on the route between the lake and Obion and Union City.

2. Raleigh, Shelby County; April 8th to 14th. A post village located on the banks of Wolf River, nine miles east of Memphis. The hilly uplands which surround the village rise above the alluvial bottoms and bayous of the river much as the same formation (Bluff Loam or Loess) does at Samburg, and the faunal and floral peculiarities of the two regions are very nearly identical, with perhaps a more obvious austral commingling than is presented at Reelfoot Lake. Short bicycle expeditions of five to ten miles were made into the surrounding country east and west of Raleigh.

3. Bellevue, Davidson County; May 17th to 24th. A post village on Big Harpeth River, twelve miles south of Nashville. The vicinity of Bellevue lies within the western edge of the fertile central basin of middle Tennessee, the country between it and Nashville closely resembling in soil, topography and faunal and floral features the blue-grass region of Kentucky. The soil is a disintegrated limestone with abundant rocky outcrop of the same and supports fine growths of poplar, walnut, ash, oak, hickory and chestnut. A range of high hills runs east and west between Bellevue and Nashville separating the two branches of the Harpeth. The mean elevation of this region is from 600 to 700 feet above sea level, its mean depression below the Highland Rim lands lying westward

between the central basin and the Tennessee River is from 300 to 400 feet.

Trips were made from Bellevue to Nashville and southward into adjoining parts of Williamson county.

4. Chattanooga and Sawyer's Springs, Hamilton County; May 24th to June 2nd.

Owing to their proximity, and the fact that my visit to Sawyer's Springs lay within the above dates (May 28th, 29th and 30th), I include both localities under one division.

Chattanooga lies between the southern base of Walden's Ridge, belonging to the Cumberland Mountain system, and the northern base of the Lookout Mountain range, on the eastern bank of the Tennessee River. Its elevation above the sea is about 800 feet; the elevation of Lookout Mountain being 1,600 feet higher, and that of Walden's Ridge about 1,800 feet above the sea. The Tennessee Valley at Chattanooga is much narrowed and circumscribed by the mountains. The bottom lands are very fertile, supporting formerly a heavy growth of poplar, oak, gum, ash and walnut; among the foothills pines and chestnut oaks are abundant.

The valley formation is limestone; that of the mountains limestone overlaid by horizontal strata of the coal measures, and topped by the sandstone table-lands which form the Cumberland plateau.

Sawyer's Springs is a health resort on Walden's ridge, about twelve miles north of Chattanooga.

Its elevation and sandy soil present us with a marked change in

Clinch River, situate among the foothills of the northern extension of Walden's Ridge at an elevation of 1,200 feet. The climate and natural productions of this region are much the same as those of the higher hills around Chattanooga. The country around Harriman is well wooded and some of the highest elevations of the Cumberland range in Tennessee are found to the north and west in Scott and Cumberland counties, Cross Mountain being 3,300 feet above the sea. A day's trip was made to Clinch River, near Kingston, at the junction of the Clinch and Tennessee rivers.

6. Allardt, Fentress County ; June 5th to 8th.

A village on the Cumberland plateau, five miles east of Jamestown, the county seat. The table land for many miles around Allardt is remarkably level, and divides at this point the drainage north and south into the Cumberland and Tennessee rivers. The soil is rather poor, supporting a growth of oak, chestnut and pine, the latter often monopolizing large tracts. The elevation may be estimated at an average of 1,800 feet. Records were made and some specimens taken on the bicycle trip from Sunbright, Morgan County, to Allardt, and on the return journey from Allardt to Rugby Road, in Scott County.

7. Knoxville, Knox County ; June 9th to 14th.

On the north bank of the Tennessee River, three miles below the junction of the French Broad and Holston Rivers. Owing to its elevation above the sea the mean temperature at Knoxville is about the same as that of Philadelphia, but the summers are cooler and winters milder.

The region is very similar to that of parts of the valley of East Tennessee already described, the fauna and flora partaking more decidedly of the Alleghenian elements found in the outlying spurs of the Chilhowee and Bay Mountain ranges on the southwest. Most of the region about Knoxville is fertile, rolling, limestone farm land, with occasional barren outcrops and ridges covered with wood. Several trips to the Holston River, and one up the east bank of that river, in the direction of Swampond Creek, were made.

8. Johnson City, Washington County; June 15th to 17th.

A picturesque town among the outlying ridges and foothills of the Great Smoky Mountains, at the junction of the E. T. & W. N. C. Narrow Gauge Railway, leading up into the Smoky Range, with the Southern Railway System. Animal and plant life show a decided admixture of species which abound on the distant mountain sides 1,000 feet higher, and some common eastern species not hitherto met with in the State, are recorded. Deciduous forests are the rule, but lowland clearings are often covered with a dense growth of pines. The elevation of Johnson City is not given in any work accessible to me, but approximates 1,400 feet.

9. Roan Mountain, Carter County; June 18th to 23rd.

The Tennessee and North Carolina State line forms an acute angle on the summit of Roan Mountain, the northwestern third of the peak belonging to Tennessee. The elevation of the peak above Roan Mountain Station at is base is 3,000 feet—the total elevation being 6,394 feet. Roan Mountain Station is twelve miles from the top of the mountain, and the country lying between these points along the valley and cañon of the Doe River formed the field of investigation in this region. On the return journey a walk of thirty miles was taken, down the headwaters of Rock Creek twelve miles, and thence across to the Doe River Valley and Roan Mountain Station. This ended the Tennessee trip so far as it related to field work in natural history.

On the summit of Roan Mountain we have a reproduction, with local variations, of the fauna and flora of the Canadian zone.

This gives place, at a lower elevation of 4,500 feet to 5,000 feet above the sea, to the deciduous flora of the Alleghenian region with a corresponding change in animal life, and this gradation from the biological conditions of the north to those of the Carolinian fauna is among the White Mountains, neither are its plants and animals subjected to those frigid winter temperatures which their New England congeners must suffer. In consequence there is a correlation in the animal and plant life of these distant localities without identity. In some cases this variation amounts to specific values, in others only subspecific, but in all, owing to their isolation, the habitat is clearly definable.

Tennessee comprises within its limits an unusually varied topography, and owing to its proximity in the west to the influence of the Gulf of Mexico by way of the Mississippi, and in the east to the lofty mountain ranges, the State presents a fauna and flora of great diversity and unusual interest to the biologist. The greater part of what is popularly known as West Tennessee is in the Louisianian* fauna, including all the country lying west of a line running north from Lawrenceburg, Lawrence County, to the intersection of the Kentucky state line by the Tennessee River. Animals characteristic of this fauna, which rarely, if ever, are found in Middle Tennessee are the two Marsh Hares, *Lepus aquaticus* and *L. palustris*; a Cotton Rat? *Sigmodon*; a small Mole Shrew, *Blarina*; a large Deer Mouse, *Peromyscus*; the Swallow-tailed Kite, *Eleanoides forficatus*; Mississippi Kite, *Ictinia mississippiensis*; Snake Bird, *Anhinga anhinga*; Prothonotary Warbler, *Protonotaria citrea*; Louisiana Tree-frog, *Hyla cinerea semifasciata*; Say's Chain Snake, *Ophibolus getulus sayi*; Louisiana Triton, *Diemyctylus viridescens meridionalis*; Cyclops Water Snake, *Natrix cyclopion* and the Alligator Snapper, *Macroclemys lacertina.*

From the western boundary of the Louisianian fauna, as above defined, the whole of Middle and East Tennessee, below an altitude of 3,000 feet, is included in the Carolinian fauna. Characteristic animals of this fauna in Tennessee are the Opossum, *Didelphys marsupialis*; Pine Mouse, *Microtus pinetorum*; Least Mole Shrew, *Blarina——?* and typical forms of the eastern Deer Mouse, Gray Squirrel, Wood Rabbit, and the Gray Fox; also the Acadian Flycatcher, *Empidonax acadicus*; Yellow-breasted Chat, *Icteria virens*; Kentucky Warbler, *Geothlypis formosa*; Blue-winged Warbler, *Helminthophila pinus*, and Bewick's Wren, *Thryothorus*

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*Zoogeographic nomenclature used is that of Dr. J. A. Allen. Bull. Amer. Mus. N. Hist., IV, Art. XIV, 1892.

bewickii. Among reptiles may be mentioned the Pine-tree Lizard, *Sceloporus undulatus;* Nebulous Toad, *Engystoma carolinense;* Pilot Snake, *Coluber obsoletus,* and Box Tortoise, *Terrapene carolina.* Many of these are found in the Louisianian fauna, but attain their maximum development and numbers in the Carolinian.

Elevations between 3,000 and 5,000 feet in the Cumberland Plateau and the Unaka and Great Smoky Mountain systems of East Tennessee, are in the Alleghenian fauna. Some of the representative animals of this area are the Red Squirrel, *Sciurus hudsonius;* Mole Shrew, *Blarina talpoides;* Brown Shrew, *Sorex personatus;* Canadian Warbler, *Sylvania canadensis;* Least Fly-catcher, *Empidonax minimus;* Wilson's Thrush, *Turdus fuscescens;* Dusky Salamander, *Amblystoma jeffersonianum* ; Black Salamander, *Desmognathus nigra,* and northern Spring Frog, *Rana clamitans melanota.*

On the highest mountain tops, in the evergreen timber belt, above 5,000 feet elevation, are found a few animals whose position belongs more strictly to the Canadian than the Alleghenian fauna. These are the Mountain Deer Mouse, *Peromyscus* —— ? Great Red-backed Vole, *Evotomys carolinensis*; Bog Vole, *Synaptomys* —— ? ; Winter Wren, *Troglodytes hiemalis;* Golden-crowned Kinglet, *Regulus satrapa,* and Common Crossbill, *Loxia c. minor.* A few of the Alleghenian reptiles extend into the Canadian fauna to the very summit of Roan Mountain.

The following annotated list of the reptiles and amphibians of Tennessee includes only those species collected by me during the recent reference to Dr. Holbrook's Herpetology, and to the check-lists of Yarrow and Cope of the collections in the National Museum.

I have largely adopted the nomenclature and sequence of orders and genera used by Professor Garman in his valuable Synopsis of the Reptiles and Amphibians of Illinois. The code of nomenclature of the American Ornithologist's Union is responsible for any apparent idiosyncracies of names or spelling that may appear.

The collection numbers 270 specimens, classed as follows : Chelonia, 45; Sauria, 27; Ophidia, 46; Anura, 63; Urodela, 89.

So far as I have been able to discover, the whole number of species and subspecies of Reptilia and Amphibia recorded from Tennessee is 77, of which 52 are represented in the collection; besides these there are about 30 species which are likely to be found in the State limits, making the approximate number of Tennessee species and subspecies 107.

REPTILIA.

Order CHELONIA.

Family EMYIDÆ.

Genus TERRAPENE Merrem.

1. **Terrapene carolina** (L.). Box Tortoise.

Not observed in west Tennessee but found in the middle and eastern districts and abounding among the foothills of the Cumberland and Great Smoky mountain ranges.

Mr. W. E. Taylor has recently[1] suggested that Kentucky and Tennessee specimens of this animal may possibly be entitled to rank as a variety of *T. carolina.*

If by "variety" a geographic race or subspecies is meant, the five specimens recorded below show that such a conclusion would be untenable, the individual variations of Tennessee Box Tortoises being as numerous and undefinable as those of a like series from the Middle States.

A large specimen from Chattanooga has an ebony black plastron; the unkeeled carapace is of the same ground, with numerous spots and small irregular figures of gold scattered over each plate; marginal plates each with a large orange spot; top of head and anterior surfaces of fore legs yellow spotted. Two younger specimens from

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[1] Proc. U. S. Nat. Mus., XVII. 1895, p. 578–9.

Bellevue are of the orange and black type with yellow and black plastron and strongly marked keel, typical of eastern examples of same age, and the same color pattern is exhibited by the adult specimens from Johnson City, in which the keel has almost disappeared. Specimens—Bellevue, 2; Chattanooga, 1; Johnson City, 2.

Genus PSEUDEMYS Gray.

2. **Pseudemys elegans** (Maxim. Wied). Wied's Turtle.

Very abundant at Reelfoot Lake as attested by numerous shells lying about the marshes. The young, from one to two inches in diameter, were swarming in the tributaries of the lake. In all of these the red neck-stripe was strongly marked. Of numerous large turtles seen in the Wolf River bottoms near Raleigh some were probably of this species. Specimens—Samburg, 2 ad.; 15 juv.

3. **Pseudemys concinna** (Le C.). Le Conte's Turtle.

A specimen from the Wolf River has remarkably long, slender nails on the three inner toes of the fore feet, the fourth being quite short.

Specimens—Raleigh, 1 ad.; Samburg, 1 juv.

Family KINOSTERNIDÆ.

Genus KINOSTERNON Spix.

4. **Kinosternon pensylvanicum** (Gmel.). Mud Turtle.

One adult specimen from Reelfoot Lake is not distinguishable from the typical eastern examples of this species.

their lateral apices each forming the apex of an obtuse angle whose anterior side is formed by the transverse anterior face of the postgular and the oblique lateral face of the pectoral plate. Pectoral plates rhomboidal, their median suture longer than the anterior (pecto-gular) suture and their posterior (pecto-abdominal) suture equalling the length of the lateral margin of the plate. Abdominal plates rhomboidal, transversely elongate, their lateral margins slightly convex, posterior margins truncate. Upper mandible emarginate with a well defined hook. A triangular emarginate rostral shield reaches median line of orbits. A pair of barbels at symphysis of lower jaw; the cervical folds and tubercles nearly obsolete. Crown and rostrum olive; black-spotted; rest of dermal surface bluish-white; the upper head and neck streaked and spotted with irregular black lines. Two black bands pass back from the eye across and above tympanum and join on foreneck, reaching thence to forearm; continuous black stripes above and below this reach from the temples and base of mandibles to base of neck. Superior surface of legs and feet and tail irregularly marbled with black. Plastron, mandibles and claws olive yellow. Plates of carapace olive, with black margins. The skull, viewed laterally, shows a depressed interorbital, convex frontal and depressed occipital profile.

Measurements: Length of plastron (median) 41 mm.; greatest width of bridge (interaxillar width), 35.5; width of carapace between anterior margins of seventh pair of marginal plates, 53. Greatest length of skull, 23; greatest width of skull, 14.5.

The specimen above described was found dead in the Emory river, and had evidently just been thrown there by one of the numerous urchins who were fishing near the place. The anterior half of the carapace was missing. The animal was apparently two-thirds grown.

A comparison with several alcoholic specimens of *A. odoratus* of the same age, taken near Philadelphia by Dr. Jos. Leidy, shows so many decided peculiarities in the Tennessee example that I have been almost induced to give it a new name.

The most prominent of these is the truncated shape of the plastron and the rhombic outlines of the abdominal and pectoral plates, the former wholly lacking the deeply cleft emargination of the axillary border. The shape of the skull is quite different, and the carinated and serrate carapace and peculiar coloration very marked.

From *A. carinatus* it is distinguished by its dermal coloration, though it resembles it in the imbrication of the carapace.

Not having specimens of *carinatus* I am unable to make the necessary comparisons, but I find Professor Boulenger's diagnosis of that species, taken from Gray's types, to correspond too closely to the Harriman specimen to warrant naming it anything else. Professor Garman states that *carinatus* has no stripes on sides of head, which my specimen has. The southwestern habitat of *carinatus* is another reason for suspicion that the Harriman turtle is distinct.

Family CHELYDRIDÆ.

Genus CHELYDRA Schweigger.

7. **Chelydra serpentina** (L.). Snapping Turtle.

This species abounds at low altitudes throughout the State.

Specimens—Samburg, 6 juv.; Johnson City, 1 ad.

Family TRIONYCHIDÆ.

Genus ASPIDONECTES Wagler.

8. **Aspidonectes spiniferus** (Le S.). Soft Shelled Turtle.

Very abundant in West Tennessee.

Specimens—Samburg, 1 half-grown; 10 juv.

Order SAURIA.

Family IGUANIDÆ.

Genus SCELOPORUS Wiegmann.

9. **Sceloporus undulatus** (Bosc. Daud.). Brown Swift, Tree Lizard.

All the color variations defined by Professor Garman[1] are found in the series collected. The "Scorpion" is well known and much dreaded by the people of Tennessee.

Specimens—Samburg, 4 juv., 1 ad; Raleigh, 3 juv., 2 ad.

Genus OLIGOSOMA Girard.

12. **Oligosoma laterale** (Say). Ground Swift.

Distribution identical with that of *Sceleporus undulatus*. Abundant.

Specimens—Raleigh, 3 ad; Sawyer's Springs, 1 juv. ad.

Order OPHIDIA.

Family COLUBRIDÆ.

Genus THAMNOPHIS Fitzinger.

13. **Thamnophis ordinatus** (L.). Common Garter Snake.

Very few specimens of this genus were met with. A specimen of typical (?) *ordinatus* was taken on the Cumberland plateau near Clear Fork Creek in the northern corner of Morgan County, but it escaped from my pocket. A small individual in bad state of preservation was examined at Samburg and thrown away.

Specimens—Samburg, 1 juv. ad.

14. **Thamnophis ordinatus obscurus** (Cope). Plain Garter Snake.

A large garter snake which I found in a mutilated condition on the road from Cloudland to Roan Mountain Station is doubtfully referred to this variety. It has nineteen rows of scales and seven labials, and was originally about 30 inches long and an inch in diameter at the thickest part. The color of the back is a uniform greenish bronze without spots or lines saving a yellowish vertebral stripe covering the median row and half of each of the two adjoining rows of dorsal scales. The gastrostegal scales are of a uniform deep greenish azure hue. The head is dark bronze without markings.

Specimen: Base of Roan Mt. (3,500 ft.), Carter Co., 1 ad.

Genus NATRIX Laurenti.

15. **Natrix sipedon** (L.). Spotted Water Snake.

The series of smaller water snakes from Reelfoot Lake plainly demonstrates that the so-called "varieties" *fasciatus* and *rhombifer* have no correlation with faunal or geographic conditions, but are the result of individual variation, of age, and, in some instances, of sex and season. No specimens of "variety" *erythrogaster* were taken but the same remarks are undoubtedly applicable to that phase also. Strictly speaking, these names have no place in nomenclature save as pure synonyms of *sipedon*, the first name applied by Linnaeus to this species. As trinomials they are inapplicable, for the same reason, and the sooner herpetologists are willing to confine the use of trinomials to geographic races of constant and definable characters the better it will be for that branch of science. In the case of *N. sipedon* the use of these varietal names even in the liberal sense of a color phase is objectionable, as there are innumerable intermediate variations between the forms so designated which defy classification and which are as fully entitled to varietal rank as those already proposed. An instance of this is exhibited by one of the Samburg specimens which so closely resembled a blacksnake that I had originally put it in the same jar with a *Bascanion* from that locality. This specimen, apart from its color, is a typical *N. sipedon*. In life it was dull black over the whole upper surface, below clear white with fine mottling and shading of steel blue across the bases of the gastrosteges. There are no traces of spots or bands above, either on the outer dermal covering or on the portions of the underlying skin which have been exposed by handling. Prof. Garman mentions that sometimes the upper colors are uniform, from which I infer he means without spots, but Prof. Cope[1] makes no mention of such a phase.

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[1] Rept. & Amphib. of Ills. p. 258–9.

Two specimens from the Nolachucky and Tennessee Rivers are alike in their rusty olive upper shades and orange-yellow bellies finely spotted with sparse black dots. In one of these the dark dorsal blotches are rhombiform and confluent; in the other they are square, separated by light, transverse bands and alternated along the sides by smaller squares of the same color. In another specimen from the Nolachucky the general appearance is similar to these but the belly is white, nearly spotless anteriorly but darkly blotched and tesselated with black, distally. The dorsal pattern is a curious mixture of those exhibited by the two specimens described in the preceding paragraph. Young specimens from Bellevue and Roan Mountain show similar inconsistencies with any popular or scientific classification.

Specimens: Samburg, 6 ad.; Bellevue, 2 juv.; Sawyer's Springs, 2 ad.; Harriman, 1 juv.; Knoxville, 1 ad.; near Greeneville, (Nolachucky Riv.), 2 ad.; Doe River (4,000 ft.), 1 juv.

16. Natrix cyclopion (Dum. Bibr.). Cyclops Water Snake.

Four specimens of this huge water snake from Samburg are remarkably uniform in coloration. The upper ground is dark olive. Beginning at the base of the skull irregular squarish blotches of black alternating with patches of the ground color extend almost to the end of the tail and occupy the middle eight rows of dorsal scutes. On the sides, opposite the olive dorsal squares and touching the corner of the black dorsal squares are squares of the same size and color reaching to and invading the abdominal scutes. The whole effect is a regular checker-board pattern. The lower head and neck are yellow, unspotted. Remainder of lower parts becoming paler yellow distally and increasingly blotched with alternating double and treble rows of rounded spots on the bases of the gastrosteges until at the ventral region they assume a checker-work pattern similar to that of the back. The three largest specimens have twenty-seven dorsal scale rows, the smallest, twenty-five. The largest specimen was nearly five feet long and contained two cat-fish, one of which would weigh a pound and a half and whose pectoral spines protruded through the skin of the snake nearly an inch on either side of the abdomen.

This species was abundant on the shores of Reelfoot Lake and its large, triangular head, thick body and similar color pattern prevent its being distinguished by the natives of that locality from the deadly moccasin, with which they almost invariably confound it. The original spelling of the specific name for this species, *cyclopion*, should be adhered to.

Specimens: Samburg, 3 ad.; 1 juv.

17. **Natrix leberis** (L.). Seven-striped Water Snake.

Not seen except in the central basin. In a large specimen from Bellevue there are no black dorsal stripes. The back is uniform olive brown with a pale whitish stripe along margins of outer dorsal scutes, succeeded by a blackish stripe on edges of abdominal scutes which is distinct from the next yellow stripe anteriorly, but is merged ventrally with the inner black stripe of belly. The median, yellow, inferior stripe disappears on the abdomen, and wholly fades in the black of the ventral and caudal regions. This results in the diminution of the pectoral pattern of five light and four dark stripes to an abdominal striation of two obscure light lateral lines, and an unbroken intervening dark area formed by the confluence of the seven light and dark median stripes of the pectoral region into a single band of black. Two young, taken with this specimen, show faint vertebral and costal stripes, and in all other respects are normal. The above description seems to show an approach to *grahami*, but its nineteen dorsal scale rows and color pattern are nearer *leberis*. Its peculiarities lend some color to the idea that *grahami* is not specifically separable from *leberis*, and Prof. Cope's

Genus BASCANION Baird, Girard.

19. Bascanion constrictor (L.). Black Snake.

Fairly abundant in sparsely settled districts.

Specimens—Samburg, 1 ad.; Bellevue, 1 ad.

Genus COLUBER Linnæus.

20. Coluber obsoletus Say. Pilot Snake.

I found this the most abundant snake throughout the State. The large specimen from Fentress County has only twenty-three rows of dorsal scales, all the others have twenty-five, bringing the average far below the normal number for this species, which is never less than twenty-five, and often reaches twenty-nine rows. In the twenty-five-rowed specimen the prevailing color is black, with slight marbling of gray above. The supralabials and anterior lower scutes are white, becoming heavily blotched with alternating quadrate spots of black,on the belly. The lower caudal region is quite black. The dorsal color pattern is rhomboidal, and there is a tendency to striation in the gray lateral markings of the fore part of the body. The specimen was nearly five feet long. It is plainly referable to the form described by Holbrook as *Coluber alleghaniensis.* A young specimen from the same locality has the same color pattern, but is much lighter.

Three specimens from Samburg exhibit very instructive characters. The smallest, a half grown specimen, has a gray-black ground with a black dorsal row of separated rhomboid blotches and a similar row of blotches on each side which are alternate to the dorsal ones, but do not touch them. The belly is white, with alternating tesseræ of black spots on either side in short longitudinal rows from three to five scutes in length, and one-eighth to one-sixteenth of an inch in width. Another large specimen is similar, but darker, the dorsal blotches less defined, and the lateral ones merged into a dark longitudinal band with a superior narrower band of gray traversing almost the entire length. The under side is white mottled with dusky anteriorly, but with a continuous median light stripe to tip of tail. It is intermediate between *allegheniensis* and *quadrivittatus.* A large Chattanooga specimen is intermediate between the Allardt and Samburg examples. No specimens of the very dark form of typical *obsoletus* were seen, though I examined several other Samburg specimens which were not preserved. A study of Professor Boulenger's diagnosis of this species[1] corroborates my own observations and belief that individuals which may be severally classed under the varietal synonyms *allegheniensis*, *lindheimeri*, and *spiloides* may be found associated in both Carolinian and Austroriparian districts. As in the case of *Natrix sipedon* these facts defy any attempt to define geographical races of *obsoletus* or to apply names to them in the trinomial sense.

Ophidians are not subservient to the same fixed laws of geographic variation which apply to birds and mammals, and which have enabled us to define with scientific exactness the faunal areas over which they are distributed, to designate these races by trinomials, and even to predict the character of sub-specific variations in a given area upon our knowledge of the physiographic and climatic conditions there obtaining. Though recent attempts to classify the North American Reptilia and Batrachia by the code of trinomial nomenclature adopted by the American Ornithologists' Union has in many cases been a failure, it is not improbable that when reptiles are collected in large series, and at different seasons from continuous areas of country we may be able in most cases to define geographic races on *structural* characters quite as constant as the superficial ones afforded us by sub-species of birds and mammals.

Specimens—Samburg, 2 ad., 1 juv.; Chattanooga, 1 ad.; Allardt, 1 juv.; 1 ad.

Genus OPHIBOLUS Baird, Girard.

21. **Ophibolus triangulus** (Daud.). King Snake, Milk Snake.

and *sayi* of the west are so constant as to deserve trinomial recognition.

Specimen: Samburg, 1 ad.

Genus HETERODON Beauvais, Latreille.

23. **Heterodon platyrhinus** Latr. Hog-nosed Snake.

Of the three Samburg specimens one adult is noteworthy in having the body and tail a uniform grayish olive above and ashy white below, without markings. The head and neck have the normal black markings.

Specimens: Samburg, 2 ad., 1 juv.

Genus CARPHOPHIS Gervais, D'Orbigny.

24. **Carphophis amoenus** (Say). Ground Snake.

In the Raleigh specimen there are no internasal scutes. In one from Sawyer's Springs the right internasal is partly developed and in the other both internasals are present.

Specimens: Raleigh, 1 ad.; Sawyer's Springs, 2 ad.

Family CROTALIDÆ.

Genus CROTALUS Linnæus.

25. **Crotalus horridus** L. Timber Rattlesnake.

I did not actually meet with this snake, but secured the rattle of a specimen killed near Samburg during my stay. They are numerous in West Tennesseee.

Genus AGKISTRODON Beauvais.

26. **Agkistrodon contortrix** (L.). Copperhead.

This snake is abundant in the western half of the State. Two specimens were caught in the runways of mice in the small "Cyclone" traps which were used for trapping mammals. This would indicate that small rodents are a favorite food of the Copperhead and are systematically pursued in their burrows.

Specimens: Samburg, 2 ad.; Raleigh, 1 ad.; Sawyer's Springs, 1 juv.

27. **Agkistrodon piscivorus** (Lacep.). Water Moccasin.

Though the Moccasin is accounted abundant by the people of Reelfoot Lake, I did not secure or positively recognize more than one specimen.

Specimen: 1, half-grown.

AMPHIBIA.

Order ANURA.

Family RANIDÆ.

Genus RANA Linnæus.

28. **Rana pipiens** Schreber. Leopard Frog.

The small series at my disposal prevents any discussion of the supposed characters of the subspecies recognized by Prof. Cope in his Batrachia of North America. The inconstancy of some of these characters, however, is patent enough and the multiplication of new trinomials quite unwarranted.

Specimens: Samburg, 1 ad.; Raleigh, 2 ad.; Chattanooga, 1 juv.

29. **Rana palustris** Le C. Pickerel Frog.

Only found in east Tennessee.

Specimens: Harriman, 1 ad.; 1 juv.; Roan Mt., (3,500 ft.) 1 ad.; 1 juv.

30. **Rana clamitans** Bosc Mss., Sonn., Latr. Southern Spring Frog.

The most abundant of the genus throughout the State.

Specimens: near Bellevue, 3 juv. ad.; Chattanooga, 1 ad.; Harriman, 1 ad.

31. **Rana clamitans melanota** (Raf.). Northern Spring Frog.

Two large frogs from a spring on the summit of Roan Mountain and within a few yards of the Tennessee State line, in Mitchell County, North Carolina, showed such striking differences from

Rafinesque's description (Annals of Nature, 1820, p. 5) is as follows:

"25. *Ranaria* (*Rana L*) *melanota*. Back olivaceous black, a yellow streak on the sides of the head, chin, throat and inside of the legs whitish, with black spots; belly white, without spots. A pretty frog, living in Lake Champlain and Lake George; vulgar name Black Frog: total length two and a half inches. Eyes large, iris gilt violet. The anterior feet have four free toes, and the hind feet five palmated ones."

There is little doubt that Rafinesque had in hand the same large, dark variety of *clamitans* which Holbrook had; the yellow streak on the side of the head (which is faintly developed in the figure of *horiconensis* and which is seen in the Roan Mountain frogs as an irregular whitish yellow stripe from the nostril under the eye to the angle of the mouth) is not a valid objection to this view. The fact that Holbrook's type also came from Lake George, and that the name of "Black Frog" is applicable to it, is further proof of their identity. The same frog from Lake Superior was named *Rana nigricans* by Agassiz in 1850. Professor Cope does not think the variation of the northern form of *clamitans* constant, and he cites a a dark Louisiana example. I am inclined to believe, however, that we have in eastern North America a light colored smooth-skinned, medium-sized Spring-frog in the Carolinian fauna, and a large dark, shagreened Spring-frog peculiar to the Canadian fauna. The name and description of *fontinalis* of Le Conte is not more applicable to the northern form than the southern, and he gives no habitat. The name *clamitans* was first given to this species in Sonnini and Latreille's Natural History of Reptiles, in 1802. Daudin, who generally gets the credit of this name, spelt it *clamata* in his Natural History of Reptiles in 1803, and gives himself the credit of naming it in Latreille's work above cited. Bosc would appear to have sent this name when he sent the types and description to Latreille and Daudin from South Carolina, and so far as I can discover, he has a right to some credit for the name. To accord this to him, and at the same time indicate the publishing author, I have adopted the formula, "Bosc Mss., Sonn., Latr."

The spelling "*clamitans*" will have to be adopted, as it has priority.

It is not only bad form, but unscientific and misleading to indicate the authorship of published manuscript names by only giving the name of the manuscript author, and it is to be hoped that a proper formula for such names will be proposed by the A. O. U.

32. **Rana catesbiana** Shaw. Bull Frog.

Abundant in all lowlands throughout the State.

A very large Samburg example is remarkably dark beneath, the entire lower parts being coarsely ocellated and vermiculated with black on a white ground ; the head quite black above, the body sooty black. A smaller specimen from the same locality is light olive above, and nearly immaculate below.

Specimens: Samburg, 2 ad.; Nolachucky River, Greene County, 1 juv.

Family ENGYSTOMIDÆ.

Genus ENGYSTOMA Fitzinger.

33. **Engystoma carolinense** Holbr. Nebulous Toad.

The specimens taken were found under logs in woodland, near running water.

Specimens: Raleigh, 1 ad.; near Chattanooga, 1 ad.

Family BUFONIDÆ.

Genus BUFO Laurenti.

34. **Bufo lentiginosus** (Shaw). Southern Toad.

Specimens from southern Tennessee approach nearly to those found in the Gulf States, but the majority are intermediates.

the State. Prof. H. Garman considers the size of *gryllus* (1.4 in.) as given by Le Conte as the only reliable difference. This is much larger than any in my series, and as the Samburg specimens are smaller and more slender than those from the Cumberland plateau, the theory that the southwestern frogs are larger than northeastern ones is contradicted. Le Conte defines the habitat of *gryllus* in the south Atlantic States, and that of *crepitans* in the remainder of the eastern United States, but Prof. Cope's identification of the Smithsonian series allots specimens of both forms to both sides of the Allegheny Mountains in such a way that faunal definitions lose their significance. Such being the case I have lumped the entire Tennessee series under the original specific name.

Specimens: Samburg, 10 ad.; Chattanooga, 2 ad.; Sawyer's Springs, 12 ad.; Greeneville, 4 ad., 4 juv.

Genus CHOROPHILUS Baird.

37. Chorophilus triseriatus (Wiedm.). Chorus Frog.

A male and female were taken together in a pool on the Chickamauga battle field, eight miles from Chattanooga. I heard the voice of this species in other parts of the State but do not remember it west of the central basin.

The specimens have been mislaid.

Genus HYLA Laurenti.

38. Hyla cinerea semifasciata (Hallow.). Hallowell's Tree Frog.

The name of the typical eastern form of this species has a rather peculiar history. Later authors have adopted the name *carolinensis* of Günther, (Cat. Bat. Sal., B. M., 1858, p. 105). Günther in his synonymy quotes a "*Calamita carolinensis*, Penn., Zool. Arct. II, p. 331," and, contrary to good rules, our most noted writers in this branch of science have used the name binomially as "*Hyla carolinensis* Pennant."

Reference to the Arctic Zoology shows us that Pennant not only never imposed original binomials or polynomials on previously unnamed species but that the "*Calamita carolinensis*" of Günther is mythical. The entire reference to it by Pennant is as follows:

"Fr.[og] with the back gibbous, cinereous, and smooth: belly yellow and granulated; on each side from the nose to the rump is a line; the same on the outside of the thighs and legs; toes bullated at their ends. Inhabits Carolina.'' On the margin of the same page he gives the number ''13'' and the English specific name ''Cinereous,'' belonging to the description. He gives no synonymy nor reference to Catesby as in the description of frogs immediately preceding this one, and there is little doubt that he based this Cinereous Frog on a specimen in his possession preserved in spirits and sent him from ''Carolina.'' On a preceding page he considers the same frog as figured by Catesby, viz.: the ''Green Tree Frog, Catesby II, 71,'' to be identical with the ''*Rana arborea*'' of Linnaeus.

How Günther could have imposed such a forgery as ''*Calamita carolinensis* Pennant,'' on himself seems inexplicable and that this *nomen spurium* should have been perpetuated to the present day as a valid name is scarcely less astonishing. Professors S. and H. Garman seem to have had doubts about the name *carolinensis* and the former in his work on the Herpetology of Illinois rightly adopts the name *cinerea* of Schneider (*Calamita cinerea* Schn., Hist. Amph. 1799, p. 174) for this species.

On examining Schneider's description the mystery is largely explained. Under the division ''XI, *Cinereus*'' of his genus ''*Calamitæ*'' it begins with the following sentence: ''In Pennanti Zoologia Arctica II, p. 331, edit. sec. Calamita Carolinensis describitur sub eodem nomine veluti species nova.'' The remainder of Schneider's description is a latinized version of the one given by Pennant above quoted. Günther mistook Schneider to mean that Pennant had of nose), short, wide, black-bordered costal stripe, no femoral stripe, back yellow-spotted. Should a larger series from the Mississippi Valley and the Gulf States show no intergradation, *semifasciata* is a good species and, in any event, has evident sub-specific claims to a place in nomenclature.

Specimens: Samburg; 3 ad., 1 juv.

39. Hyla pickeringi (Storer). Pickering's Tree Frog.

Storer's description and name (Rept. of Mass., 1839, p. 240), of this species are the first published ones. He was indebted to the manuscript Journal of the Essex County Natural History Society for the description. This journal was afterward published in 1852, and the manuscript referred to is given in the table of contents as "Remarks on Hyla (Femoralis) Pickeringii observed in the North Parish of Danvers. By Andrew Nichols. . . . p. 593."

Storer was a good friend of Holbrook. He does not seem to have published his "*Hylodes pickeringi*" as new, as he omits the "nobis" used after such species. He also omits giving any author's name, but gives the synonymatic reference, "N. A. Herpet., Vol. III." This refers to the first edition of Holbrook's work which probably had not been issued from the press when Storer wrote his description. This accounts for Storer not giving the page reference. Holbrook's Herpetology came out in 1838, one year before the date of Storer's work, but it contains no reference to *H. pickeringi*. In the second edition published in 1842 the description and plate appear but there is no reference to Storer.

The whole thing is difficult to interpret, but so far as our evidence goes Storer has the best of it and sole claim to the name. It is probable, however, that Holbrook had suggested to Storer that the animal would be named after Dr. Pickering in his forthcoming third volume of the N. A. Herpetology and Storer innocently so used the name in his manuscript and inadvertently allowed it to get into print in that form before Holbrook had published it. Holbrook's disregard of Storer's previous use of the name is inexplicable.

Only heard in the mountains of the eastern region.

Specimen: Roan Mt. (6,300) ft., Mitchell Co., N. Car., (200 yds. east of Tennessee line), 1 ad. ♂.

Order URODELA.

Family PLEURODELIDÆ.

Genus DIEMYCTYLUS Rafinesque.

40. Diemyctylus viridescens meridionalis (Cope).[*] **Spotted Triton.**

About forty of these Newts were brought alive to me by a boy who had taken them in a stream flowing into Reelfoot Lake. They were the only specimens observed by me in Tennessee. The series is remarkably uniform in size, averaging about three inches in length. The coloration is likewise remarkably constant; dark olive above with round dots of black evenly distributed, becoming clouded on the tail. Lower parts clear, light yellow, dotted with black. Tail strongly keeled above and below. The entire series lacks any indication of the lateral, red, black-ringed ocelli so uniformly present in *viridescens.*

The name *miniatus* given by Rafinesque to this species in the same issue of the Annals of Nature containing his description of *viridescens,* must give place to the latter name, which was the first in the order of sequence.

The occurrence of the *meridionalis* type of this species in the Mississippi bottoms of Tennessee is of much interest and seems quite parallel to that of *Hyla cinerea semifasciata* above mentioned, both cases showing the close faunal relationship of this region with eastern and southeastern Texas.

Specimens: Samburg, 14.

Family PLETHODONTIDÆ.

Genus SPELERPES Rafinesque.

44. **Spelerpes ruber** (Sonn. Latr.). Red Salamander.

The large specimens from Sawyer's Springs were found under logs in dry woodland. The color in life was light brownish red, darkly and thickly spotted with black. The larval Roan Mountain specimen was taken in a quiet pool of water. A well defined slender black vertebral line reaches from the shoulders to end of tail. In other respects it is like Prof. Cope's diagnosis of *S. r. montanus*, to which variety (subspecies?) it undoubtedly should be referred. A specimen was seen in a spring on the summit of Roan Mountain.

Specimens: Sawyer's Springs, 3 ad.; Roan Mountain (4,000 feet) 1 juv.

45. **Spelerpes bislineatus** (Green). Two-striped Salamander.

Very abundant under logs just below the fir belt on Roan Mountain.

Specimens: Roan Mountain (4,500 to 5,000 feet), 7 ad.

Genus GYRINOPHILUS Cope.

46. **Gyrinophilus porphyriticus** (Green). Porphyritic Salamander.

The only specimen coming to notice was taken under the upper bark of a huge hemlock log in the deciduous belt of Roan Mountain at about 4,000 feet elevation. Its length is not quite five inches. A thread-like, black, vertebral line extends from shoulders to root of tail. The dorsal spotting is minute, the lower parts immaculate save the border of the lower jaw. A dark line from nostril to eye. Color above, in life, pale salmon. This species is not essentially an aquatic animal, as the above capture proves, the nearest stream of water being fifty yards from the tree on which I found the specimen.

Specimen: Roan Mountain, near Rock Creek, 1 ad.

Genus PLETHODON Tschudi.

47. **Plethodon glutinosus** (Green). Viscid Salamander.

This is the most abundant and uniformly distributed salamander in Tennessee. None were found on Roan Mountain.

Specimens: Samburg, 1 ad., 1 juv.; Raleigh, 7 ad.; Sawyer's Springs, 5 ad., 5 juv.; Knoxville, 1 juv.

48. Plethodon æneus Cope. Web-footed Salamander.

This species was found associating with *glutinosus* on the Cumberland table land near Chattanooga, which is in the type region. The specimens were taken under the bark of rotten tree stumps about three feet from the ground. Prof. Cope states "the terminal phalanges are truncate and slightly expanded at the tips, as in the *P. glutinosus*" In my specimens this truncation and expansion is greatly exaggerated, especially on the hind feet, the tips of the toes being nearly twice the diameter of the phalanges; the latter are distinctly webbed and the soles and palms wider than long. The inner toes of both hind and fore feet do not stand out from the plantar circumference save as a right-angled border, being practically nonfunctional as compared with the same members in *glutinosus*. In other characters, including measurements, my adult specimen is a duplicate of the type. The young individual is twenty-five millimeters long, but in all respects, except size, corresponds to the adult.

Specimens: Sawyer's Springs, 1 ad., 1 juv.

49. Plethodon erythronotus (Green). Red-backed Salamander.

So far as I can identify the specimens on hand, this species is found in both middle and west Tennessee. The series appears to confirm the belief, based on collections from Pennsylvania, that the form *cinereus* is not a geographic but an individual variation which may often be found in direct association with *erythronotus* in a single colony. *Erythronotus*, on account of its precedence over *cinereus* in Dr. Green's original descriptions, should stand for the species, *cine-*

Specimens: Roan Mountain (4,000 to 5,200 ft.), 13 ad.

51. **Amblystoma opacum** Gravenhorst. Ladder-back Salamander.

Specimen: Raleigh, 1 ad.

Family CRYPTOBRANCHIDÆ.

Genus CRYPTOBRANCHUS Leuckart.

52. **Cryptobranchus allegheniensis** (Latr.). Hellbender.

A specimen was taken from the interior of a water snake, *Natrix sipedon*. The anterior half of the body is much macerated, but the remainder is in good condition. The animal is about two-thirds grown; the ground color a greenish olive, spotted, in strong contrast with irregular transverse bands and blotches of black. The abdomen is sparingly spotted with the same shade. In all other specimens I have examined the general shade was leaden and the marbling obscure or absent altogether.

Specimen: Tennessee River, near Knoxville, 1 juv. ad.

List of Reptiles and Amphibians Recorded from Tennessee not Mentioned in the Preceding Annotated List.

Order CROCODILIA.

1. ALLIGATOR MISSISSIPPIENSIS (Daud.). Alligator.

I was assured by Mr. J. A. Craig, of Samburg, that he had seen Alligators in the Mississippi near Memphis.

Order CHELONIA.

2. PSEUDEMYS TROOSTI (Holbr.). Troost's Terrapin.

The type was sent to Dr. Holbrook from the Cumberland river, probably near Nashville. Troost mentions this species in his list of Tennessee reptiles.[1]

3. PSEUDEMYS HIEROGLYPHICA (Holbr.). Hieroglyphic Terrapin.

The above remarks also apply to this species. The type of *hieroglyphica* is in the Museum of the Academy of Natural Sciences of Philadelphia.

4. MALACLEMYS GEOGRAPHICA (Le Sueur). Map Terrapin.

Holbrook and Troost record it, the former from the Cumberland river.

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[1] 7th Geol. Rep. Tenn., 1844, p. 39.

5. Macroclemys lacertina (Schweig.). Alligator Snapper.

Numerous in Reelfoot Lake. This is the "*Chelonura Temminckii*" of Troost's list. It is probably found throughout west Tennessee in the larger streams.

6. Amyda mutica (Le S.). Leather Back Turtle.

This is Troost's "*Trionyx miticus*" in the list of Tennessee reptiles.

7. Aspidonectes nuchalis Agass. Tennessee Soft-shelled Turtle.

The types of this species came from the Cumberland river near Nashville and young of the same are recorded by Agassiz from the headwaters of the Tennessee River. I observed an *Aspidonectes*, perhaps this species, in the Tennessee River at the junction of the Holston and French Broad.

The validity of this species is not well established.

The "*Trionyx ferox*" of Troost's list refers chiefly to *A. spiniferus* which was then confounded with *ferox*.

Order SAURIA.

8. Ophisaurus ventralis (L.). Joint Snake.

Recorded by Troost, and likely to be found in Tennessee anywhere, west of the higher mountains.

9. ?Phrynosoma cornutum (Harl.). Horned Toad.

This is given on the authority of Troost's list. I am not aware of any record east of the Mississippi River. Troost's record may have been based on a specimen escaped from captivity, as it is impossible

Order OPHIDIA.

11. **Storeria dekayi** (Holbr.). De Kay's Snake.

Recorded from Tyree Springs in Dr. Yarrow's list of Reptilia and Batrachia in the U. S. National Museum.

12. **Diadophis punctatus** (L.). Ring Snake.

Yarrow (l. c.) records it from Tyree Springs and Troost includes it in his list.

13. **Virginia valeriæ** Bd. Gir. Valeria's Snake.

Yarrow's list names a specimen from Tyree Springs.

14. ? **Agkistrodon atrofuscus** (Troost). Highland Moccasin.

So far, the specific peculiarities of this snake depend solely on the statements of its describer. I saw or heard nothing of such a snake that did not apply to *A. contortrix*. It is not impossible that the animal may be rediscovered but the probabilities are strongly against it. The type came from Maury County, Tenn.

15. **Crotalophorus catenatus** (Raf.). Massasauga Rattlesnake.

Troost includes the "*Crotalus miliarius* Lin.," in his list of Tennessee Reptiles, undoubtedly referring to this species, which represents *miliarius* in the Mississippi Valley.

Order ANURA.

16. **Scaphiopus holbrooki** (Harlan). Spadefoot Toad.

This is the *S. solitarius* of Troost's list.

17. **Hyla versicolor** Le C. Common Tree Frog.

Specimens from Roane, Claiborne, and Shelby counties are recorded in Yarrow's list. Troost also gives it.

Order URODELA.

18. **Diemyctylus viridescens** (Raf.) Spotted Triton.

This is the "*Triton dorsalis* Harl." of Troost's list.

Typical *viridescens* undoubtedly replaces the race *meridionalis* in middle and east Tennessee and is the form referred to by Troost, whose researches were chiefly devoted to the region around Nashville.

19. **Spelerpes longicaudus** (Green). Long-tailed Salamander.

The "*Salamandra longe caudata*" of Troost's catalogue refers to this species. See also, Batr. N. Amer. 1889, p. 170.

20. **Spelerpes guttolineatus** (Holbr.). Holbrook's Triton.

Another species admitted on Troost's authority.

21. **Amblystoma punctatum** (L.). Spotted Salamander.

The "*Salamandra venenosa*" of Troost's list is this species. A specimen from Knoxville is in the National Museum.

22. **Cryptobranchus fuscus** (Holbr.). Brown Hellbender.

The type of this species was taken by Prof. Mitchell in the Tennessee River near Knoxville. Yarrow records a specimen from Nolachucky River.

23. **Amphiuma means** (Garden). Congo Snake.

Listed by Troost. The most northerly record I can find.

24. **Necturus maculatus** (Raf.). Mud Puppy.

Specimens from Tyree Springs are listed. Troost also gives it a place in his list under the name "*Menobranchus lateralis* Say."

Order TRACHYSTOMATA.

25. **Siren lacertina** L. Siren.

This species is given in Troost's list.

List of Reptiles and Amphibians likely to occur in the State, but not yet recorded therefrom.

Order CHELONIA.

1. **Onychotria triunguis** (Agass.). Three-toed Tortoise.
2. **Chrysemys picta** Herrmann. Painted Turtle.
3. **Chrysemys marginata** (Agass.). Western Painted Turtle.
4. **Malaclemys lesueuri** (Gray). Le Sueur's Terrapin.

15. ABASTOR ERYTHROGRAMMUS (Daud.). Red-lined Snake, Hoop Snake.

16. FARANCIA ABACURA (Holbr.). Red-bellied Horn Snake.[1]

17. LIOPELTIS[2] VERNALIS (De Kay). Green Snake. Spring Snake.

18. PITUOPHIS CATENIFER SAYI (Schl.). Bull Snake.

19. COLUBER GUTTATUS L. Corn Snake.

20. HETERODON SIMUS (L.). Hognose Snake.

21. HALDEA STRIATULA (L.). Little Striped Snake.

22. VIRGINIA ELEGANS (Kenn.). Kennicott's Brown Snake.

Order ANURA.

23. RANA SYLVATICA Le C. Wood Frog.

24. HYLA SQUIRELLA Bosc. mss., Sonn., Latr. Squirrel Frog.

Order URODELA.

25. HEMIDACTYLIUM SCUTATUM (Schl.). Four-toed Salamander.

26. CHONDROTUS MICROSTOMUS (Cope). Small-headed Salamander.

27. AMBLYSTOMA TIGRINUM (Green). Tiger Salamander.

28. AMBLYSTOMA CONSPERSUM (Cope). Sprinkled Salamander.

29. AMBLYSTOMA TALPOIDEUM (Holbr.). Mole Salamander.

Order TRACHYSTOMATA.

30. PSEUDOBRANCHUS STRIATUS (Le C.). Striated Siren.

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[1] Mr. B. C. Miles, of Brownsville, Tennessee, writes me that he has taken this snake in the bottoms.

[2] I here adopt Fitzinger's genus in good faith. He made *Herpetodryas tricolor* of Schlegel the type of this genus. Should it prove that Prof. Cope's assertion (Proc. A. N. Sci., Phila., 1860, p. 560), that this species is generically similar to our *vernalis*, is incorrect, there seems to be no other generic name strictly applicable to it. Prof. Cope's appropriation of Fitzinger's genus *Liopeltis* as his own (Proc. N. Mus., Vol. XIV, p. 620) is not only inconsistent with his well-known views on the "catalogue names" of that author, but is in plain violation of the "Code."

PRELIMINARY NOTE ON A NEW ALKALI MINERAL.

BY WARREN M. FOOTE.

While searching recently at Borax Lake, California, for the rare species Sulphohalite, Mr. C. H. Northup discovered what he considered to be a new form of that mineral.

The crystals were found during a laborious working of the tailings which came from an exploratory boring known as the "New Well," made by the Borax Lake Mining Company, and were formed in a clay which was reached at a depth of about 450 feet. They were at once forwarded to Dr. A. E. Foote, to whom the writer is indebted for the material used in this examination.

Crystallization, etc. — The mineral crystallizes in bright and perfect octahedrons of a diameter rarely exceeding one centimeter. Fractured crystals show in the interior a cross formed of faint lines running perpendicular to the octahedral faces. Dark planes (which were sharply defined in the interior of every specimen examined), lie parallel to cubic symmetry thus passing through the angles of the octahedron and dividing it into eight parts, each part containing a distinct group of striæ.

The same thing is noticeable in the clearest of the complete

Pyrite, Bologna 1893). Again, triangular markings on the surface and a frequent parallel grouping of the octahedrons suggest a form of interpenetration twinning, where the twinning axis is cubic as in diamond.

Color, varying from milky, pale yellow and greenish gray to brown. Cleavage, imperfect. Fracture, brittle and uneven. Lustre, vitreous. Hardness, 3.5 to 4.

Chemical Examination.—Easily fusible. In a closed tube decrepitates violently and gives off water, finally fusing to a gray mass. Fragments and powdered mineral are almost unchanged by long standing in water and the powder soluble with difficulty on boiling. Readily soluble with effervescence in cold dilute hydrochloric acid. Qualitative tests made on clear crystals, showed the presence of carbon dioxide, chlorine and sodium with slight traces of calcium and potassium, making it essentially a *chlorocarbonate of sodium*, a composition quite as remarkable as that of other species peculiar to this locality.

Though found sparingly, it is hoped that material can be obtained for a further and more complete investigation than the writer is at present able to give.

The name NORTHUPITE is proposed for this new species, since it was entirely due to Mr. Northup's indefatigable zeal in collecting, that the mineral was brought to light.

DESCRIPTION OF A NEW GENUS AND SPECIES OF COTTOID FISHES FROM PUGET SOUND.

BY EDWIN CHAPIN STARKS.

COTTIDÆ.

JORDANIA, new genus.

Allied, but not closely, to *Triglops* and *Chitonotus.*

Body elongate, not greatly compressed; head moderate, partly scaled, with dermal flaps above. Mouth moderate, with bands of villiform teeth on jaws, vomer and palatines. Body above lateral line closely covered with strongly ctenoid scales; lower half of body with narrow, parallel plate-like folds of skin, running obliquely downward and backward from lateral line to within a short distance of anal fin, the posterior edge of each fold finely and sharply serrate. Gill-membranes united, free from isthmus; a slit behind last gill. Spinous dorsal with very long base, of about 17 spines, longer than the soft dorsal; anal long; ventrals 1+5, inserted behind base of pectorals by a distance equal to snout and half eye.

I take pleasure in naming this remarkable genus for my teacher in ichthyology, David Starr Jordan.

villiform bands on jaws, vomer and palatines; eyes large, set high in head, a little shorter than snout; interorbital space deeply concave, half as wide as eye; a slip of skin, half as long as the diameter of the eye, over the anterior edge of each eye, and a longer one over the posterior edge; a few minute fleshy slips on nape; nasal spines long and sharp, somewhat curved backward; spine on preopercle simple, hooked upward, a minute spine above it, and a blunt spine below; posterior end of interopercle prominent, forming a blunt spine; opercle produced posteriorly in a flap, which lies in a shallow groove in the shoulder-girdle; no opercular spine; gill-membranes united, but not joined to the isthmus; a distinct slit behind fourth gill arch; branchiostegals 5.

Top of head to middle of eyes, opercles and upper part of preopercles, closely covered with small rough scales; head otherwise naked; body above lateral line completely covered with ctenoid scales, not very regular in size, arranged in about 67 series; lower half of body covered to within a short distance of anal with about 50 oblique plate-like folds of skin, the posterior edges of which are finely and sharply serrate; the pores of lateral line are situated in the upper ends of these folds; base of pectoral, belly and a narrow space along base of anal, naked; fins, all naked, with the exception of pectoral, which has a few rough scales on the rays; vent situated at anterior end of anal fin.

Dorsal spines slender, the first one inserted in advance of base of pectoral, directly over the upper end of gill-opening; the fin somewhat rounded in outline, the spines not varying greatly in length, with the exception of two or three on each side, which are shortened; soft dorsal a little lower than spinous, the rays sub-equal; the base is a little shorter than the base of first dorsal, and slightly longer than the length of head; ventral fins, long, inserted behind base of pectorals, by a distance equal to snout and half eye, their tips reaching past front of anal fin, their length equal to the distance from snout to edge of preopercle; the pubic bone very prominent; pectoral fins long and curved upward, the middle rays the longest, reaching far past tips of ventrals and front of anal to the space between dorsals, the ends of lower rays free; the width of the fin at its base contained 3 times in the length of the head; caudal rounded.

Color in spirits blackish, with traces of 4 or 5 darker cross bars on back; sides below lateral line mottled, faint dark spots along lateral line, more conspicuous posteriorly; a dark bar half as wide as eye, running from eye downward across cheek to anterior end of interopercle; bordered on each side by a light streak, a similar bordered bar running across top of head, slightly turning around posterior margin of orbit, downward along margin of preopercle, and ending on posterior end of interopercle; snout abruptly black, lips dark; fins all dark and slightly mottled; tips of ventral, anal and caudal rays a little lighter; caudal and pectoral dark at base; slips on top of head black; belly very finely dusted with minute dark points.

This species is not uncommon in Puget Sound; the types are three specimens taken on channel rocks at Point Orchard, near Seattle, by Miss Maud Parker and Mr. Adam Hubbart, members of the Young Naturalists' Club of Seattle. The largest of them is 4 inches in length. The types are in the Museum of the Leland Stanford Junior University. Unfortunately the life colors of this brilliant species were not taken. There is, in life, much red on the lateral plates and elsewhere on the body and fins. This disappears at once in alcohol.

NEW SPECIES OF FUNGI FROM VARIOUS LOCALITIES.

BY J. B. ELLIS AND B. M. EVERHART.

Fomes alboluteus E. & E.

On charred trunks of *Abies subalpina* Eng. Mountains of Colorado, 10,000 ft. alt. July 1894. Prof. C. S. Crandall.

Effused and laterally connate for several centimeters, about 1 cm. thick and 5–6 cm. broad, immarginate and entirely resupinate or, in some specc. with a very slight, reflexed margin, of soft, spongy texture and light orange color within and without. Pores large, 1-2 mm. diam., with a thin, membranaceous, white, toothed margin. The spores perhaps from immaturity could not be satisfactorily made out.

Grandinia fuscolutea E. & E.

On underside of rotten logs and limbs lying on the ground, Newfield, N. J., Oct. 1894.

Membranaceous, soft, 1-10 cm. diam., bright-yellow, lutea, at first and tuberculose-granulose, becoming darker and smoother in drying; margin white, cottony or arachnoid; granules small, whitish at the apex. Spores, elliptical, dull yellow, 5—6 × 3 μ. On clavate-cylindrical basidia about 15 × 6 μ, with 2—4 short, 4—5 μ, sporophores. The hymenium at length becomes rimose, exposing the white subiculum.

Peniophora trachytricha E. & E.

On bark of decaying oak limbs, Newfield, N. J., Oct. 1894.

Thin, milk-white at first, becoming yellowish and thicker as the hymenium forms, extending along for 6 inches or more, surface at first minutely granular, at length floccose-tubercular, resembling *Kneiffia*. Margin thin granular-cottony. Cystidia subcylindrical, coarsely tubercular-roughened, or sometimes with the upper part smooth and the tip swollen. 100–120 × 10–12 μ, the free projecting ends about 40–50 μ long, basidia clavate-cylindrical 12–15 × 3½–4½ μ. Spores oblong, obtuse, 7–8 × 3–3½ μ, hyaline.

Apparently allied to *P. hydnoides* Cke. and Massee.

Bovista cellulosa E. & E.

Beneath the surface of the ground. Fort Collins, Colorado, August 1894. C. F. Baker, No. 302.

Inner peridium depressed-globose, 1–1½ cm. diam., coriaceous, tough, grayish outside, clothed around the sides with a honey-colored, favose-cellulose coat 1–2 mm. thick, and this again clothed with a thin, grayish-yellow membrane to which the soil adheres externally forming with this membrane, an outer peridium 1–1½ mm. thick and separating from the cellular layer with a clean, smooth surface. Capillitium homogeneous, filling the inner peridium, olivaceous, composed of simple or sparingly branched threads 3–4 μ thick and yellowish-hyaline, with abundant, globose, slightly roughened or wrinkled, olivaceous spores 3–4 μ diam.

This is closely allied to *Bovista circumscissa* B. & C. from which it differs in its cellular coat and smaller, not so distinctly roughened spores. *B. circumscissa* has spores 5½–6½ μ diam.

Lycoperdon alpigenum E. & E.

On the ground at the timber line, above, Cameron Pass, N. W. Colorado, alt. 11,500 ft., July 1894. Prof. C. S. Crandall. No. 17.

About 2 cm. diam. Peridium coriaceous, about 1 mm. thick, brown outside and rimose-squamulose above. Capillitium rudimentary, consisting of a few coarse, 6–10 μ diam., sparingly branched or entirely disconnected, yellowish brown threads without any attachment. Sterile base occupying about ⅓ part of the cavity, pale yellowish. Spores globose, nearly smooth 3½ μ diam., with a

Perithecia gregarious, erumpent-superficial, globose, 75–110 μ diam. surrounded by a crooked, branching, creeping mycelium which blackens the surface of the stem, and clothed with straight, black, 3–4–septate, spreading, bristles, 75–110 μ long and 6–7 μ thick at base, tapering above to an obtuse point. Asci clavate-cylindrical, sessile, 55–65 × 10–12 μ, 8-spored. Paraphyses obscure or wanting. Sporidia crowded fusoid, 4-septate, the next to the upper cell swollen, 22–30 × 4–4½ μ, slightly curved, yellowish-hyaline.

Distinguished from *A. decastylum* Cke., by its smaller perithecia, with more abundant bristles and by the swollen joint of the sporidia.

Herpotrichia purpurea E. & E.

On dead culms and leaves of *Deyeuxia Sukadorfii* Scrib. Easton, Wash., July, 1892. Prof. C. V. Piper, No. 344.

Perithecia scattered, superficial, hemispherical, ½–¾ mm. diam., clothed with a dense coat of purple hair 90–140 × 3–3½ μ, continuous or sparingly septate, soon deciduous above, leaving the apex of the perithecium and the papilliform ostiolum bare.

Asci cylindrical, 40–50 × 3–7 μ, short-stipitate, aparaphysate, 8-spored. Sporidia biseriate, fusoid-oblong, hyaline, becoming faintly uniseptate, very slightly curved, subobtuse, 9–14 × 1½–2 μ.

Letendraea luteola E. & E.

On decayed wood. Ohio (Morgan No. 1,109.) Perithecia gregarious, superficial, thick-membranaceo-carnose, ⅓–½ mm. diam., yellow-farinose-pubescent above, mostly more or less collapsing. Ostiolum short-cylindrical, stout. Asci cylindrical, 75–85 × 5–6 μ, attenuated below into a stipe 30–35 μ long, indistinctly paraphysate, 6–8-spored. Sporidia, uniseriate, oblong, slightly narrowed at each end, but obtuse, often slightly inequilateral, uniseptate, but not constricted, pale-brown, 8–11 × 3–3½ μ, lying end to end in the asci.

Rosellinia geasteroides E. & E.

On decaying stem of *Arundinaria*, St. Martinville, La., July, 1895. Rev. A. B. Langlois, 2,404.

Perithecia gregarious, superficial, depressed-globose, ¾ mm. diam., with a distinct, papilliform ostiolum, wall of the perithecium double, the outer coat membranaceous, soon splitting into about 5 reflexed lobes, and resembling a minute *Geaster*. Asci cylindrical, 100–110

(p. sp. 75–80) x 6 μ, paraphysate, 8-spored. Sporidia uniseriate, inequilaterally-elliptical, soon opake, 10–12 x 5 μ.

Rosellinia limoniispora E. & E.

Proc. Acad., Phil. 1894, p. 326. The habitat of this species was erroneously given as on *leaves* of *Fraxinus*. It should be on dead shoots or limbs of *Fraxinus* buried in the ground. Mr. B. also finds it on dead limbs of *Ailanthus* and of *Juglans cinerea* in similar situations, its entire growth and development being subterraneous. In the specc. on *Ailanthus* there are traces of a thin, light colored (cinereous) subiculum more or less distinct. The young perithecia are ovate-globose, but become more or less flattened above.

Rosellinia muriculata E. & E.

On inner surface of bark of *Populus monilifera*, Rockport, Kansas, Dec., 1894. E. Bartholomew, No. 1,613.

Perithecia superficial, ovate, slightly contracted below, 200–220 x 180–200 μ, clothed with a short, white pubesence; ostiolum minute, papilliform. Asci cylindrical, 75 x 6–7 μ p. sp. 55–60 μ long. Short-stipitate, paraphysate, 8-spored. Sporidia obliquely uniseriate, oblong elliptical, pale brown, 8–10 x 4–5 μ.

The white pubescence soon disappears, leaving the perithecia black and muriculate-roughened.

Melanopsamma borealis E. & E.

On inner surface of loosened bark of fir trees, Newfoundland. Rev. A. C. Waghorne.

obtuse, 3–septate and slightly constricted at the septa, sometimes very slightly curved, pale-olivaceous 9–11 x 3–3½ μ.

Melanomma nigricans E. & E.

On rotten wood. Ohio. Morgan.

Perithecia densely crowded, forming a nearly continuous layer on the surface of the blackened wood, small (150–200 μ), subglobose, nearly glabrous; ostiolum papilliform. Asci clavate-cylindrical, short-stipitate, paraphysate p. sp. about 55 x 12 μ. Sporidia biseriate, oblong-fusoid, slightly curved, obtuse, mostly a little narrower at one end, hyaline at first, soon pale-brown, 3-septate, 14–17 x 4½–5½ μ.

Some of the perithecia are smaller and contain oblong-elliptical, brown, uniseptate and constricted spores 8–11 x 5–6 μ. *Diplodia.*

M. fuscidulum Sacc. has the sporidia about the same but the perithecia are rather larger, with a cylindric-conoid ostiolum, and are scattered or only gregarious and do not blacken the wood.

Melanomma subcongruum E. & E.

On outer bark of cottonwood trees. *Populus monilifera*, Rockport, Kansas, Sept. 1894. E. Bartholomew No. 1,584.

Perithecia gregarious or erumpent-superficial, the base remaining more or less sunk in the bark, ovate, slaty-black and muriculately roughened below, ½–¾ exceptionally 1 mm. diam. The conical perforated ostiolum black and shining.

Asci clavate-cylindrical, 150–190 x 12–14 μ, p. sp. 114–120 μ long, surrounded by abundant, filiform paraphyses, 8-spored. Sporidia overlapping-uniseriate, oblong, a little narrower at the lower end, obtuse, slightly curved, 3–5–septate, slightly constricted at the septa, pale brown.

Allied to *M. medium* Sacc. and Speg. and to *M. juniperinum* Karst. but differs from both in its much larger perithecia and longer asci, and from the former in its 3–5–septate sporidia.

Ceratostoma melaspermum E. & E.

On rotten wood. Ohio, Morgan No. 1,041.

Perithecia gregarious, buried, depressed-globose, membranaceous, ½–¾ mm. diam., with a straight, black, erumpent beak about 1 mm. long, obtuse and often expanded at the top into a small, horizontal, circular disk, and surrounded at the base with spreading, light-yellow hairs forming a loose, tomentose-pilose tuft. Asci cylindrical, short-stipitate, 65–75 x 6–7 μ, with faint paraphyses. Sporidia uniseriate, navicular, 2-nucleate, 12–15 x 5–6 μ, hyaline at first, becoming opake and nearly black.

One would expect this to be *Sphaeria investita* Schw., Syn. N. Am. 1,621, but the specc. of that species in Herb. Schw. are not distinguishable from *Ceratostomella cirrhosa* (Pers.) except in having a small patch of yellowish-brown tomentum around the base of the ostiola.

Ceratostoma albomaculans E. & E.

On rotten wood. Ohio. Morgan.

Perithecia entirely buried, large (1 mm. diam.), membranaceo-coriaceous, 1–3 together. Ostiola erumpent, ovate-conical, black, smooth. Asci cylindrical, p. sp. 75–80 x 7 μ, paraphysate. Sporidia uniseriate, inequilaterally elliptical, obtuse 1–2–nucleate, olive-brown, 11–14 x 5–6 μ.

The ostiola are erumpent in a yellowish-white subelliptical spot 1–2 mm. in diameter.

C. avocetta C. & E. has the perithecia only half as large and the sporidia smaller; the white spots also, under which the perithecia are buried, seem to be characteristic.

Amphisphaeria confertissima E. & E.

On weatherbeaten wood, Ohio. Morgan.

Perithecia superficial, subglobose, 210–220 μ diam. slightly papillate-roughened, black, densely crowded in oblong patches ½–1 cm. long and 2–3 mm. wide or often by confluence of greater extent. Ostiolum papilliform, black. Asci cylindrical, short-stipitate, p. sp. 55–60 x 8 μ, paraphysate, 8-spored. Sporidia obliquely uniseriate, ovate-elliptical, brown, uniseptate and constricted, 9–11 x 5–6 μ.

Comes near *A. Spegazziniana* Sacc. but that has larger, short-fusoid, sporidia and (sec. fig. in F. Ital. 135), slightly swollen each side of the septum.

Amphisphaeria pilosella E. & E.

On decaying wood of some deciduous tree. Ohio. Morgan, No. 1,103.

Perithecia gregarious, superficial, subcarbonaceous, minute, 200–250 μ diam., subglobose, slightly collapsing above, sparingly clothed at first with short, pale, weak, spreading hairs. Ostiolum papilliform, minute, but distinct. Asci cylindrical, 65–70 x 6 μ, narrowed below into a stipe 25–30 μ long, p. sp. 55–60 μ long, indistinctly paraphysate, 6–8-spored. Sporidia uniseriate, lying end to end in the asci, oblong-elliptical, uniseptate, but not constricted, pale brown, 7–10 x 3½–4 μ.

Differs from *A. Oronoensis* in its larger, pilose, sub-collapsed perithecia and rather larger sporidia.

Teichospora nitida E. & E.

On dead stems of *Rubus deliciosus*, Rist Cañon, Colo., April, 1894. Prof. C. S. Crandall, No. 108, and on *Rubus villosus*, Nuttallburg, West Va., May, 1895. L. W. Nuttall, No. 706.

Perithecia thickly scattered, ovate-globose, 350–400 μ diam., at first covered by the epidermis which is raised and pierced by the black, papilliform ostiola, at length, when the epidermis falls away, superficial. Asci clavate-cylindrical, paraphysate, 8-spored, 90–110 x 11–13 μ. Sporidia uniseriate or subbiseriate above, oblong-elliptical, obtusely pointed, 3–5-septate, with a longitudinal septum running through part or all the cells, 15–20 x 8–10 μ, pale, yellowish-brown, slightly or not at all constricted in the middle.

The West Va. specc. have the perithecia rather smaller 250–300 μ diam.

Teichospora minima E. & E.

On a dry oak post, mixed with *Rosellinia pulveracea* Ehr., var. *microspora*, Rockport, Kansas, Oct., 1894. E. Bartholomew 1,591.

Perithecia scattered, small 100–110 μ, collapsing, nearly smooth, with a papilliform ostiolum. Asci clavate-oblong, short-stipitate, 50 x 12–15 μ p. sp. 40–46 μ long, paraphysate, 8-spored. Sporidia crowded-biseriate, elliptical, about 5-septate, not constricted, 12–15 x 7–8 μ, olive brown.

Differs from *T. pygmaea* E. & E. in its smaller, collapsed perithecia and shorter asci.

Lophiostoma clavisporum E. & E.

On dead culms of *Elymus Canadensis*. Rooks Co., Kansas March 18, 1895. Bartholomew, No. 1,694.

Perithecia scattered or gregarious, buried, except the erumpent, thin, flattened ostiolum, 300 x 150 μ, culms mostly blackened on the surface. Asci clavate-cylindrical. short-stipitate, paraphysate, 40–60 x 12 μ. Sporidia crowded in the asci, clavate, 3–5-septate, mostly constricted at the septa, yellow-brown, 20–27 x 5–6 slightly curved, obtusely rounded above, gradually narrowed belo

Differs from *L. insidiosum* in the sporidia being without appendages.

Lophiostoma Dakotense E. & E.

On decorticated limbs of Cottonwood, *Populus monilifera.* Dakot Oct., 1894. Prof. T. A. Williams, No. 151.

Perithecia gregarious, semi-immersed, subglobose, 200–250 μ, diam., black-brown, with a conical, slightly compressed ostiolum. Asci clavate-cylindrical, short-stipitate, 65–75 x 10–12 μ, with abundant, filiform paraphyses. Sporidia biseriate, oblong-fusoid, uniseptate at first, soon becoming 3-septate and constricted at the septa, nearly straight, hyaline, or at length subolivaceous, 15–20 x 5–6 μ. Accompanied by a *Phoma* with perithecia erumpent-superficial, 100–120 μ, diam., soon collapsed to almost cup-shaped, and with oblong-elliptical sporules, 2–3 x 1–1½ μ, smoky-hyaline. Near *L. duplex* Karst. but is smaller in all its parts.

Cucurbitaria stenocarpa E. & E.

On dead stems of *Rhus diversiloba.* Pasadena, Cala., Aug., 1884. Prof. A. J. McClatchie, No. 766.

Perithecia in groups of 2–6 together, bursting out through short, narrow-elliptical, longitudinal cracks in the epidermis and not rising much above it, subglobose, 350–400 μ diam., brownish-black, rough, collapsing, with a small, papilliform ostiolum. Asci cylindrical, Accompanied by a *Pleospora* not distinguishable from *P. Herbarum* (Pers.).

Sphærella vagans E. & E.

On dead stems of *Valeriana sylvatica* Gray and *Castilleia miniata* Dougl.

On the slope of Mt. Richtophen, N. W. Colorado, 9,500 ft. alt.

Perithecia scattered, subcuticular, becoming superficial by the peeling off of the epidermis, depressed-globose, or subelliptical, of tough, coarse cellular structure, perforated above, 250–300 μ in the longer diameter. Asci cylindrical, subsessile, p. sp. 55–60 x 7–8 μ. Sporidia biseriate, ovate, uniseptate, constricted at the septum, hyaline, 12–16 x 5–7 μ. Mixed with the ascigerous perithecia were spermogonial perithecia containing oblong-elliptical hyaline sporules 5–6 x 2 μ, but whether belonging to the *Sphærella* or to *Leptosphæria concinna* E. & E. found on the same stems, is uncertain.

Physalospora Corni E. & E.

On dead twigs of *Cornus*. Fort Collins, Colorado, March 1895. C. F. Baker, No. 329.

Perithecia thickly scattered, globose about 200μ diam. white inside, covered by the blackened-epidermis, which is raised into pustules barely pierced by the papilliform ostiola. Asci clavate-cylindrical, 70–90 x 11–13 μ, short-stipitate, aparaphysate. Sporidia biseriate, navicular-fusoid, continuous, hyaline, very slightly curved, 20–26 x 4–5 μ.

Didymella Ricini E. & E.

On dead petioles of *Ricinus communis*, Louisiana. Langlois, No. 2,414.

Perithecia gregarious, minute, 110–150 μ, subcuticular, raising the epidermis into black, flattish pustules resembling a young *Vermicularia*, scattered singly or sometimes 2-3 in the same pustule, Ostiola inconspicuous. Asci oblong-clavate, very short stipitate, 45–55 x 8–10 μ. Sporidia biseriate, oblong, obscurely nucleate, becoming uniseptate, not constricted, curved, obtuse, hyaline, 13–18 x 4–4½ μ.

There is no stroma or any circumscribing line.

Didymosphæria Celtidis E. & E.

On dead limbs of *Celtis occidentalis*. Rooks Co., Kansas, May, 1895. E. Bartholomew.

Perithecia thickly scattered, globose, small, about 300 μ diameter, covered by the epidermis which is raised into pustules pierced above by the papilliform ostiolum. Asci ventricose-oblong, sessile, 55–60 x 18–25 μ, obscurely paraphysate, 8-spored. Sporidia crowded-biseriate, obovate, uniseptate and slightly constricted, brown, 20 x 10 μ, or sometimes regularly elliptical, 20–25 x 10–12, μ, both in the same ascus.

The asci soon disappear and then the fungus may be mistaken for a *Diplodia.*

Pleospora Coloradensis E. & E.

On dead stems of *Polemonium confertum* Gray. Cameron Pass, N. W. Colo., above timber, July, 1894. C. F. Baker, No. 273.

Perithecia scattered, subcuticular, subglobose, 200–230 μ, diam., of coarse, dark cellular structure, with a scanty mycelial fringe around the base. Ostiolum papilliform, or conic-papilliform, perforating the epidermis. Asci oblong, short-stipitate, 100–130 x 25–30 μ, with paraphyses more or less distinctly branched. Sporidia biseriate, oblong or ovate-elliptical, scarcely or often distinctly constricted in the middle, yellow-brown, 6–8-septate and becoming clathrate-muriform, ends mostly rounded and obtuse, 27–35 x 12–15 μ, slightly compressed.

The sporidia much resemble those of *P. juncicola* E. & E., but are not so much compressed, and the perithecia are smaller than in that species, with walls of finer cellular, structure, having a reddish tinge

Leptosphaeria lethalis E. & E.

On dead stems of *Pentstemon confertus.* Latah Co., Idaho, July, 1894. Prof. C. V. Piper, No. 330.

Perithecia erumpent-superficial, gregarious, subglobose, ¼–⅓ mm. diam., with a papilliform ostiolum. Asci clavate-cylindrical, 50–60 x 7–8 μ, with abundant paraphyses, 8-spored. Sporidia fusoid, slightly curved, 3-septate not constricted, unless slightly so at the middle septum, 50–60 x 3½–4 μ.

The perithecia appear on the living stems which are soon blackened and killed.

Leptosphaeria concinna E. & E.

On dead stems of *Castilleia miniata* Doug. Mt. Richtophen, N. W. Colo., July, 1894. C. F. Baker, No. 271, partly.

Perithecia scattered, subcuticular, subglobose, 200–300 μ diam., at length semiemergent, but still more or less covered by the blackened cuticle; ostiolum papilliform. Asci clavate-cylindrical, 70–80 x 7–10 μ, paraphysate, short-stipitate. Sporidia biseriate above, fusoid, pale-yellow, 5-septate, slightly curved, one or two of the middle cells slightly swollen, 20–27 x 3–4 μ.

L. Ogilviensis R. Br., has the asci and sporidia larger; in *L. tenera* Ell., they are smaller, and in *L. agnita* the sporidia are 6–7-septate and larger.

Metasphaeria quercina E. & E.

On dead twigs of *Quercus coccinea,* var. *tinctoria.* Newfield, N. J., June, 1895.

Perithecia gregarious, buried, globose, 250–300 μ diam., raising the blackened epidermis into pustules pierced at the apex by the papilliform ostiolum. Asci cylindrical, short-stipitate, 170–190 x 12 μ. Paraphyses filiform, shorter than the asci. Sporidia uniseriate, oblong, 3-septate, and constricted at the septa, hyaline, 20 x 7–9 μ.

Differs from *M. Fiedleri* (Niessl), in its cylindrical asci and cylindrical-oblong, not fusoid, straight sporidia.

Ophiobolus Helianthi E. & E.

On dead stems of *Helianthus Maximiliani.* Rockport, Kansas, March, 1895. Bartholomew, No. 1,681.

Perithecia scattered, erumpent-superficial, ovate-globose, about ¼ mm. diam. Asci clavate-cylindrical, p. sp. 40 x 7–8 μ, paraphysate, 8-spored. Sporidia fasciculate, elongated-fusoid, brownish in the asci, nearly hyaline when free, 3-septate, not constricted, nearly straight, about 40 x 3½–4 μ.

Ophiobolus purpureus E. & E.

On dead stems of some Umbelliferous plant, on Mt. Richtophen, N. W. Colo., alt. 9,500 ft., Aug 1894. C. F. Baker, No. 277.

Perithecia gregarious, buried on parts of the stems stained purple-red, ovate-globose, about 250 μ diam., covered by the blackened epidermis which is raised into slight pustules and pierced by the prominent-papilliform ostiolum. Asci clavate-cylindrical, sessile, paraphysate, obtuse, 80–100 x 12–15 μ. Sporidia crowded, elongated-fusoid, moderately curved, about 6-septate, 50–65 x 5–6 μ, one cell, near the middle, swollen, yellowish-brown.

Differs from *O. porphyrogonus* (Tode) and *O. consimilis* E. & E. in its broader asci and sporidia. *O. fulgidus* C. & P. has the perithecia emergent and no swollen joint in the sporidia.

Thyridium pallidum E. & E.

On dead limbs of *Rhus glabra*. Rooks Co., Kansas, May 1895. Bartholomew No. 1,711.

Perithecia scattered, depressed-globose, about ⅛ mm. diam., sunk in the surface of the inner bark, dirty white above, covered by the epidermis which is perforated by the conic-papilliform, amber-colored ostiola, but not raised into pustules. Asci cylindrical, 110–130 x 12 μ, short-stipitate, paraphysate. Sporidia uniseriate, oblong-curved, 13–16 x 3½–4 μ, brown with a hyaline, minute, subglobose appendage at the lower end. The perithecia are mostly scattered singly, but here and there they are collected in groups of 3-4, with their ostiola collected in a fascicle.

This differs from *A. stegophora* (Mont.) in its scattered or grouped· not, seriate, perithecia, and in its permanently oblong appendiculate sporidia ; from *A. Bambusæ* Lev. in the absence of any stroma.

Valsa leucopsis E. & E.

On bark of *Fraxinus viridis*? Cody, Nebraska, March 28, 1893. Rev. J. M. Bates. Comm. Prof. Thos. A. Williams.

Stroma, depressed-conical, ¾-1 mm. diam., orbicular, consisting of the nearly unaltered substance of the bark, the flattened apex erumpent and snow-white. Perithecia 6-12, circinate in the bottom of the stroma, about 150 μ diam., abruptly contracted above into slender necks, their black, punctiform ostiola, erumpent through the snow-white disk but not exserted. Asci clavate-cylindrical, 22–27 x 5–6 μ. Sporidia biseriate above, allantoid, hyaline, slightly curved, 5–6½ x 1–1½ μ

Has the outward appearance of *Valsa leucostoma* (Pers.) or *V. nivea* (Hoff.), but the asci and sporidia are smaller and there is no conceptacle enclosing the stroma, besides the different habitat.

Eutypella alpina E. & E.

On dead trunks of *Alnus incana*. Larimer Co., Colo., July 1895. Alt. 7,000 ft. C. F. Baker, No. 363.

Stroma seated on the wood, depressed conical, orbicular or elliptical, 3-4 mm. diam., white inside, enclosed in a stout, black, subcarbonaceous shell, circumscribed by a black line penetrating the wood. Perithecia 20-30 in a stroma, monostichous, crowded, ovate-globose, ½ mm. diam., necks slender, rising through the white substance of the stroma and terminating in a compact fascicle of stout, subglobose, quadrisulcate ostiola erumpent through transverse cracks in the epidermis or closely surrounded by it. Asci, p. sp., 22–24 x 4–5 μ, long stipitate, with stout, nucleate paraphyses exceeding them in length. Sporidia subbiseriate, allantoid, yellowish, moderately curved, 7–10 x 1½–2 μ.

Differs from *E. similis* (Karst.) in its larger sporidia from *E. alnifraga* (Wahl.) in the shorter spore-bearing part of the asci, and from both in the much more numerous perithecia.

Eutypella herbicola E. & E.

On dead stems of *Aster cordifolius.* Ohio. Morgan No. 1,122

Stroma elongated, 5 or more cm. long, and 2-3 mm. wide, slaty black outside, circumscribed by a black line which penetrates deepl into the substance of the stem. Perithecia globose, 300-450 μ diam not deeply buried, lying either singly or 3-10 together in valsoic groups. Ostiola erumpent, tuberculo-globose or short-cylindrica with their tips swollen, quadrisulcate. Asci, p. sp., fusoid-clavate, 30–35 x 5–6 μ, with a slender stipe. Paraphyses obscure or none. Sporidia allantoid, yellowish, slightly curved, obtuse, 6–8 x 1¾–2 μ.

Differs from *E. cerviculata* (Pers.) in its partly scattered perithecia and herbicolous growth, in which respect it approaches *Cryptosphæria.*

Diatrypella Fraxini E. & E.

On dead limbs of *Fraxinus viridis.* Rooks Co., Kansas, July, 1895. E. Bartholomew, No. 1,783.

Stroma cortical and convex, 2–3 mm. diam., formed of the slightly altered substance of the bark, without any distinct circumscribing line. Perithecia 8–12 in a stroma, globose, 250–300 μ diam., ostiola united in a brownish-black, erumpent disk, only slightly projecting, becoming 4-cleft. Asci clavate, 110 x 12 μ, long-stipitate, paraphysate, polysporous. Sporidia crowded, allantoid, yellowish-hyaline, curved, 6–8 x 1¾–2 μ.

The stromata raise the bark into distinct pustules, to the sides of which the lobes of the ruptured epidermis closely adhere.

Melogramma boreale E. & E.

Stroma interruptedly effused continuous for 2–4 cm., or subrobicular, ½–1 cm. across, about 1 mm. thick, margin abrupt, sometimes the upper edge slightly projecting, conidial layer rusty-red, same color as in *H. perforatum* (Schw.) Perithecia monostichous, ovate, ½–⅓ mm., the apices only slightly prominent, with small, papilliform ostiolum, finally perforated. Asci cylindrical, rather long-stipitate, abundantly paraphysate, 8-spored, p. sp. 90–110 x 7–8 μ. Sporidia uniseriate, oblong-navicular, 14–18 x 6–7 μ, yellowish at first, with a single large central nucleus, finally opake.

Distinguished from *H. rubiginosum* (Pers.), by its larger sporidia.

Phyllachora Plantaginis E. & E.

On leaves of *Plantago Rügelii*, Racine, Wis., Oct., 1894. Dr. J. J. Davis, No. 943.

Epiphyllous, gregarious, on dead areas of the leaf, convex-hemispherical, black, ¼–⅓ mm. diam., or 2–3 confluent and then larger, base innate in the surface of the leaf, apex papilliform. Cells filled with oblong, hyaline, 2-nucleate stylospores 6–8 x 2–2½ μ. Asci not yet formed.

Evidently the early stage of *Phyllachora*.

Dothidella longissima (Pers.) E. & E.

Sphaeria longissima Pers., Syn. p. 31. *Phoma longissima* West. Not. III, p. 13.

Perithecia densely gregarious, seated on a thin, black subiculum forming long, narrow, black, ribbon-like strips 1–1½ mm. wide, extending from node to node on the stems, minute, slightly prominent, not confluent, covered at first by the blackened epidermis. Ostiola inconspicuous, or minutely papilliform. Asci oblong, 40 x 7–9 μ, nearly sessile, paraphysate. Sporidia biseriate, oblong, uniseptate, but scarcely constricted, obtuse, hyaline, 12–15 x 3½ μ.

On dead stems of *Chenopodium album*, Kansas. Bartholomew & Shear.

Homostegia coscinodisca E. & E.

On bark of birch trees. Newfoundland. Waghorne.

Stromata erumpent-superficial, discoid-pulvinate, ½-¾ mm. diam., pierced above with 6-8 small round openings but without any prominent ostiola. Ascigerous cells about 75 μ diam., with thin subhyaline walls so that they are not easily distinguished. Asci oblong, subsessile, 55–60 x 12–15 μ, aparaphysate, 4-8 spored. Sporidia mostly biseriate, varying from elliptical to oblong and 8–22 x 8–10μ; 3-septate and constricted at the septa, especially at the middle one, where they readily separate, obtuse at the ends, hyaline. Belongs in Saccardo's subdivision *Roumegueria* and allied to, but apparently different from *H. durissima* Berk.

Ciboria Liquidambaris E. & E.

On decaying capsules of *Liquidambar*. Naamans Creek, Delaware, May 1895. A. Commons, No, 2,710.

Gregarious stipitate, 4–5 mm. high. Ascoma about 2 mm. broad, orbicular, convex and brownish when dry, margin paler, Stipe, white or dirty-white, puberulent. Asci clavate, stipitate, 75–80 x 7–8 μ, with filiform paraphyses. Sporidia subbiseriate, oblong, hyaline, continuous, 8–11 x 3 μ.

Mollisia Asclepiadis E. & E.

On dead stems of *Asclepias*. London, Canada, July, 1895. Dearness No. 2,283.

At first covered by the epidermis, then erumpent-superficial, orbicular, ¾ mm. diam., pale slate-color, margin coarsely toothed or subentire, plano-convex, much shrunken when dry. Asci cylindrical, short-stipitate, paraphysate, 8-spored, 55–60 x 6 μ. Sporidia mostly biseriate, subinequilaterally elliptical, 2-nucleate, hyaline, 8–10 x 3 μ

Closely allied to *Peziza abdita* Ell. but disk darker, sporidia broader and ascoma not as completely withdrawn beneath the epidermis when dry.

Cenangium conglobatum E. & E.

On dead limbs of some deciduous tree or shrub. Bay of Islands, West Coast of Newfoundland, July 1895. Rev. A. C. Waghorne, No. 42.

Densely cespitose, forming compact tufts or balls 3-4 mm. diam. Ascomata cup-shaped, stag-color or ferruginous inside and out, margin light-colored and fringed with short, pale, smooth hairs, outside granulose-pilose. Asci clavate-cylindrical, sessile, 8-spored, 30 x 5–6 μ. Sporidia subbiseriate, allantoid, 2-nucleate, hyaline, obtuse, slightly curved, 5–6½ x 2–2½ μ. Paraphyses filiform, with a knob-like thickening at the tips. Asci and paraphyses have a ferruginous tint

Chlorosplenium striisporum Ell. & Dearness.

On decaying leaves. London, Canada, July 1895. Dearness No. 2,281.

Sessile, hemispherical, 1-1½ mm. diam., greenish-yellow, thin, hemispherical, with the margin incurved and toothed, rough verrucose-squamose outside, pale yellow inside, substance soft-carnose. Asci clavate-cylindrical, stipitate, p. sp. 70–75 x 15–20μ. Paraphyses filiform, longer than the asci. Sporidia irregularly crowded in the asci, elliptical, smooth and hyaline at first, pale-brown and longitudinally striate when mature, 15–20 x 9–11 μ.

Cenangella abietina E. & E.

On bark of dead *Abies*. Newfoundland. Waghorne.

Ascomata erumpent-superficial, gregarious, black, orbicular, about ½ mm. diam. with the margin thin and suberect. Asci clavate-cyclindrical subsessile, 60–75 x 12 μ, 8-spored. Sporidia biseriate, ovate-elliptical, yellowish, becoming brown, 2-nucleate, becoming uniseptate, 12–18 x 6–7 μ.

Patellea hysterioides E. & E.

On weather-beaten pine lumber. Rooks Co., Kansas. E. Bartholomew.

Ascomata erumpent-superficial, ⅓-½ mm. diam., black, the opposite sides incurved, when dry, so as to give the appearance of a *Hysterium* with an open disk. Asci obovate, 30–35 x 20 μ, with a short, nodular stipe. Paraphyses united above into a black or purplish-black epithecium. Sporidia crowded, obovate, uniseptate and constricted, 14–18 x 8–10 μ, ends rounded and obtuse hyaline.

P. stygia (B. & C.) is said to have the sporidia subattenuated at each end, which is not the case with this species.

Duplicaria acuminata E. & E.

On culms of *Juncus Drummondii*, Cameron Pass, Colo., July, 1894. Prof. C. S. Crandall, No. 83.

Ascomata scattered, shield-shaped, ¼–1 mm. diam. astomous, convex when moist, collapsing and wrinkled or ridged when dry, black and shining, manner of dehiscence not seen. Asci clavate-cylindrical, obtuse at the apex, gradually narrowed to the base, 80–110 x 11–12 μ, paraphyses none. Sporidia 8 in an ascus, irregularly crowded, bifusoid, i.e. consisting of two fusoid sporidia joined end to end, 30–35 x 2½–3 μ, hyaline, acuminate at each end, but more distinctly so below.

D. Empetri Fckl. has the sporidia larger 58 x 6 μ and obtuse at the ends. *D. Cochinchinensis* K. & H. has sporidia shorter and broader.

Phyllosticta amicta E & E.

On leaves of *Arctostaphylos viscida* and *A. Manzanita*, Jackson, Amador County, Cala., 1894. Geo. Hansen, Nos. 129 and 130.

Spots cinereous, with a narrow, reddish-purple border, orbicular, 3–4 mm. diam. Perithecia amphigenous, erumpent, depressed-globose, 120–200 μ diam., overrun with a hyphomycetous growth, *Alternaria*, which also spreads more or less over the surface of the leaf. Sporules ovate or elliptical, 7–10 x 5–6 μ, light straw-yellow.

On *A. Manzanita* the perithecia are scattered over reddish-brown dead parts of the leaf, mostly the upper half, without any definite spots. The *Alternaria* has conidia composed of globose, brown cells 7–8 μ diam., joined in toruloid threads, or collected in irregular shaped masses, or forming concatenate conidia 10–30 x 8–20 μ.

Phyllosticta Trillii E & E.

On leaves of *Trillium petiolatum*, Pullman, Wash., June, 1894. Prof. C. V. Piper, No. 341.

Spots small, 2–3 mm., round, dirty-brown, grayish in the center, margin darker, with a yellowish-shaded border. Perithecia innate, epiphyllous, globose, about 75 μ diam. Sporules oblong, hyaline, continuous, 10–14 x 2–2½ μ. On the same spots is a *Cladosporium* *C. Trillii* E. & E. Tufts effused, slate-color. Hyphae septate, Perithecia epiphyllous, solitary, one in the center of each spot, 75 μ diam. Sporules subglobose, hyaline, nucleate, 5–6 μ diam.

Phyllosticta castanicola E. & E.

On leaves of *Castanea chrysophylla*, Sisson, Cala., July, 1894. Prof. Marshall A. Howe, No. 122.

Spots epiphyllous, dark-brown, suborbicular, 2–5 mm. diam., with a narrow, dark, subfimbriate border, scarcely visible on the lower face of the leaf. Perithecia crowded on the spots, buried in the substance of the leaf, hard and tough, orbicular or elliptical, 80–100 μ diam., sometimes 2–3 confluent, the apex erumpent and broadly perforated. Sporules abundant, minute, oblong, 3–3½ x 1¼–1½ μ, hyaline. The tough, almost sclerotioid perithecia indicate that this may be the stylosporous stage of some *Phyllachora*, or other dothideaceous fungus. Very different from *Ph. Castaneae* E. & E.

Asteroma infuscans E & E. N. A. F. 3,361.

On dead stems of *Iva xanthifolia*, Fort Collins, Colo., Feb., 1895. C. F. Baker, No. 234.

Fibrils appressed, branched, radiate, at length often disappearing, leaving the surface of the stem blackened for several 5–10 cm. in extent, the blackened areas mostly surrounding the stem and more or less distinctly limited. Perithecia abundant, pustuliform, perforated above, 90–150 μ diam. Sporules oblong-elliptical, hyaline, continuous, 3–5 x 1–1½ μ.

Asteroma Parkinsoniae E. & E.

On pods of *Parkinsonia Torreyana*, Tucson, Arizona, Sept., 1893. Prof. J. W. Toumey, No. 14.

Perithecia emergent-superficial, subdepressed, 150 μ diam., at first a single one seated in the center of an appressed, gray, radiating mycelium, at length smaller perithecia appear along the radiating arms of the hyphae. Sporules oblong, hyaline, 2–3-nucleate, 15–20 x 5–7 μ, ends obtusely rounded.

Aposphaeria Ohiensis E. & E.

On rotten wood. Ohio. Morgan, No. 1,068. Perithecia gregarious, depressed-globose, minute, 150 μ, papillate. Sporules oblong-elliptical, continuous, hyaline, 2½–3 x 1 μ, borne on stout, fasciculate basidia 10–12 x 1½–2 μ below, slightly tapering above.

Dothiorella fraxinicola E. & E.

On bark of dead *Fraxinus*. Long Pine, Nebraska, June, 1895. Rev. J. M. Bates.

Perithecia erumpent-superficial, densely gregarious, or here and there collected in botryoid clusters connected by an imperfect stroma, ⅓–½ mm. diam., with a papilliform or short-cylindrical ostiolum, finally collapsing above and broadly perforated. Sporules oblong-fusoid, 18–30 x 6–7 μ, hyaline, continuous, on slender basidia about as long as the sporules.

Differs from *D. Fraxini* E. & E., and from *D. fraxinea* Sacc. and Roum. in its larger perithecia and its differently shaped sporules.

Dothiorella Crataegi E. & E.

On dead limbs of *Crataegus oxyacantha*, London, Canada, May, 1895. J. Dearness, 1,291 (b).

Stromata gregarious, erumpent, black; flattened pulvinate ½–1½ mm. or more in diameter. Perithecia small, 2–20 in a stroma. Ostiola papilliform. Sporules elliptical, smoky or subolivaceous-hyaline, 18–20 x 10–15 μ on stout basidia, but soon deciduous.

Fusicoccum quercinum E. & E.

On dead limbs of *Quercus coccinea*, var. *tinctoria*, Newfield, N. J., March, 1895.

Stromata numerous, scattered, subcuticular, tuberculo-convex, seated on the surface of the inner bark, erumpent and loosely surrounded by the ruptured epidermis, about 1 mm. diam,, white or whitish inside, obscurely multilocular, enclosed in an outer, coriaceous coat, which is irregularly ruptured above. Sporules fusoid, hyaline, continuous, mostly 2-nucleate, subobtuse, 10–15 x 3–3½ μ.

but the arrangement of the perithecia is different and sporules septate.

Diplodia Umbellulariae E. & E.

On dead twigs and limbs of *Umbellularia Californica*, Pasadena, Cala., Aug., 1894. Prof. A. J. McClatchie.

Perithecia scattered singly or oftener in short series of 3–6, bedded in the blackened, almost stromatic, substance of the inner bark and raising and splitting the epidermis into short, longitudinal cracks, through which their minute, papilliform ostiola are barely visible, 150–200 μ diam., whitish inside. Sporules elliptical, broadly constricted at the septum, dark-brown obtuse, 16–20 x 8–10 μ, on pedicels about as long as the sporules.

Similar but smaller perithecia on the same limbs produce, oblong-elliptical, pale-brown, 8–10 x 4–5 μ sporules *Coniothecium Umbellulariae* E. & E.. Other perithecia contain oblong, 5-septate sporules 25–30 x 7–9 μ, on hyaline pedicels 8–12 μ long terminal; cells of sporules hyaline, intermediate ones olive-brown. *Hendersonia Umbellulariae* E. & E.

Diplodia officinalis E. & E.

On dead limbs of *Sassafras officinalis*, New Brunswick, N. J. Prof. B. D. Halsted. Michigan, G. H. Hicks.

Perithecia evenly but thickly scattered, subepidermal, depressed-globose, 150–200 μ diam., covered by the blackened epidermis which is raised into distinct pustules pierced at the apex by the papilliform ostiola. Sporules oblong, dark-brown, septate in the middle, but not constricted, 15–22 x 7–8 μ.

Differs from *D. Sassafras* Tr. & E. in its larger sporules septate in the middle, and in growing on dead, instead of living limbs.

Botryodiplodia ostiolata E. & E.

On bark of dead *Quercus alba*. Ohio. Morgan No. 1,051.

Perithecia fasciculate, 12–20 together, conic-cylindrical, 1–1½ mm. long, white inside, joined at base in a black, subcuticular stroma, erumpent through the thick epidermis, and when growing on the side of a log or limb, curving upward. Sporules elliptical, 20–25 x 11–12 μ, uniseptate, brown.

Ascochyta zeicola E. & E.

On old stalks of *Zea Mays*, Newfield, N. J., May, 1895.

Perithecia gregarious, on slightly darker, irregular shaped or subelongated areas of the stalk, suberumpent, pierced above, 100–150 μ diam. Sporules oblong-cylindrical, hyaline, yellowish in the mass, uniseptate, not constricted, obtuse, 6–8 x 1½–2 μ.

Very different from *A. zeina* Sacc. which is on the leaves and has sporules 18 x 7 μ.

Diplodina Coloradensis E. & E.

On dead stems of *Gutierrezia Euthamiae*, Fort Collins, Colo, March, 1895. C. F. Baker, No. 333.

Perithecia subgregarious, often subseriate, erumpent-superficial, small, about 200 μ, black and shining, subglbose, with a papilliform ostiolum. Sporules oblong, obtuse, uniseptate, but mostly not constricted, smoky-hyaline, 6–8 x 2½–3 μ.

Near *D. Galii* Niessl, but apparently distinct; that species having ovate, constricted sporules.

Septoria variegata E. & E.

On leaves of *Rhamnus Purshiana*, Shasta Springs, Siskyou Co., Cala., Aug., 1894. W. C. Blasdale.

Spots numerous, dark rusty-brown, becoming light rusty-brown, 2–8 mm. diam., with a small, white spot in the center, or in the larger spots, with numerous white spots arranged so as to present a zonate or marbled appearance, as in *Septoria musiva* Pk. Perithecia epiphyllous, but often visible below, seated on the small white spots, broadly open above, 100–110 μ diam. Sporules clavate-cylindrical, irregularly curved, hyaline, nucleate, becoming 3-septate, 25–55 x 3–4½ μ.

W. C. Blasdale and *Septoria macrophylli* E. & E., MS., on leaves of *Acer macrophyllum*, Seattle, Wash., Aug., 1894, Prof. C. V. Piper, should be considered as mere varieties of *Septoria circinata* E. & E., Proc. Phil. Acad., 1894, p. 367.

Amerosporium cinctum E. & E.

On dead stems of *Gladiolus*, Pasadena, Cala., Aug., 1894. Prof. A. J. McClatchie, No. 793.

Perithecia superficial, applanate, 100–150 μ diam., membranaceous, of cellular texture, broadly open above, fringed around the base with spreading, smoky-hyaline, continuous, simple or sparingly branched hairs, 80–120 x 3 μ. Sporules short-elliptical, smoky-hyaline, obtuse, 3½–5 x 2–2½ μ.

Besides the subhyaline hairs that fringe the perithecia, other branching brown threads creeping on the surface of the *Gladiolus* stem, bear ovate, brown, conidia 1-septate at first, then 2–3-septate and submuriform, or sarcinuliform, 12–15 x 7–12 μ.

Phleospora Californica E. & E.

On leaves of *Acer Californicum*, Contra Costa Co. Cala., July, 1895. W. C. Blasdale.

Acervuli on small, 2–3 mm., pale, indefinite spots thickly scattered over the leaf, covered, especially on the upper side of the leaf, by the black, subclypeate perithecia which are obsolete or undeveloped below. Sporules cylindrical, mostly straight, 1–3-septate, 20–35 x 3½–4½ μ, hyaline, not constricted, expelled in white filiform cirrhi on both sides of the leaf.

Differs from *Phl. Aceris* (Lib.), in its black-capped acervuli and white cirrhi.

Gloeosporium castanicolum E. & E.

On leaves of *Castanea vesca*, lying on the ground, Faulkland, Del., Aug., 1887. A. Commons.

Amphigenous but mostly hypophyllous, on light-colored spots or areas of the leaf, also on and alongside of the midrib. Acervuli numerous, minute, yellowish, erumpent. Conidia fusoid, subobtuse, slightly curved, 20 x 2–2½ μ.

On the one leaf examined was an abundance of *Discosia artocreas* (Tode) forming conspicuous, suborbicular, black patches.

Cylindrosporium Rhamni E. & E.

On leaves of *Rhamnus*, sp., Shasta Springs, Cala. W. C. Blasdale, No. 283.

Spots small, 1 mm., white, subconcentrically arranged on larger, definite brown spots, 3–5 mm. diam. Acervuli epiphyllous, erumpent, seated on the white spots, black, 150–200 μ diam. Conidia cylindrical, curved, obtuse, nucleate, hyaline, 35–45 x 3½–4½ μ.

Marsonia Rhamni E. & E.

On leaves of *Rhamnus Purshiana*, Renton, Wash., Aug. 9, 1894. Prof. C. V. Piper, No. 59.

Spots suborbicular, ½–1 cm., whitish in the center, with a broad, dark-purplish border. Acervuli epiphyllous, but also visible below, flesh-colored, 200–250 μ diam. Conidia oblong or elliptic-oblong, uniseptate, hyaline, 6–8 x 2½–3 μ, not constricted at the septum.

Marsonia rubiginosa E. & E.

On leaves of *Salix*? Idaho, 1802. A. J. Mulford.

Spots numerous, small, about 1 mm. diam., or by confluence more, rusty-brown, without any distinct border, more clearly defined on the upper side of the leaf.

Acervuli numerous, 100–150 μ diam., amphigenous, but mostly erumpent below. Conidia elongated-piriform, hyaline, uniseptate near the lower end, often slightly curved, acute below, 11–13 x 2½–4½ μ. Spores smaller and spots different from any of the other species on willow leaves. Comes nearest *M. salicicola* Bres.

Melanconium crinigerum E. & E.

On bark of dead maple. Ohio, Morgan 1,130.

Ascervuli subcutaneous, convex, slate-color, 2–3 mm. diam.

common orifice and form heaps of spores resembling perithecia. The Newfield specc. are younger and not as well matured but show the same general characters as the California specc.

Sphaeropsis Alni C. & E. in Krieger's Saxon Fungi No. 847, is a true *Sphaeropsis* and different from this.

Ovularia lotophaga E. & E.

On living leaves of *Lotus Torreyi*. Sisson, Cala. , July 1894. W. C. Blasdale, No. 288.

Spots irregular or suborbicular, 2-3 mm. diam., grayish-brown, with a narrow, darker border. Hyphae subfasciculate, hyaline, continuous, simple or sparingly branched 15–25 x 2½–3 μ, subgeniculate above. Conidia subglobose or obovate-globose, 7–9 x 5–7 μ.

Ramularia circumfusa E. & E.

On leaves of *Rumex obtusifolius*. Oberlin, Ohio, May, 1894. Prof. F. D. Kelsey, No. 133.

Amphigenous. Spots small, 1-2 mm., whitish, with a brown border, thickly scattered over the leaf. Hyphae often issuing from the stomata of the leaf, very long, 100–150 x 2½–3 μ, vaguely and loosely branched, distantly septate, hyaline, assurgent, subgeniculate and toothed above, Conidia varying from ovate or oblong-elliptical, 5–10 x 2–2½ μ to cylindrical 10–15 x 2–2½ μ, hyaline, continuous, concatenate. Whether the conidia ever became septate we can not say.

Differs from *R. pratensis* Sacc. in its smaller conidia and longer hyphae, and its effused growth, spreading out around the spots so as to form white, orbicular patches 2-3 mm. diam.

Ramularia cercosporoides E. & E.

On leaves of *Epilobium spicatum*. Seattle, Wash. August 1894. Prof. C. V. Piper, No. 290.

Spots numerous, variable in size from 1-3 mm., often confluent in irregular, subangular patches ½-1 cm. diam., dark-purplish, with a dull-whitish center. Hyphae hypophyllous, few in a tuft, arising from a yellow-brown, stromatic base, subgeniculate, continuous or faintly 1-2-septate, brownish-hyaline, nucleate, 30–60 x 3½ μ. Conidia terminal, oblong-fusoid, hyaline, at first continuous, finally narrowed in the middle and 1, or more, septate, 15–30 x 4–5 μ.

Cercosporella Baccharidis E. & E.

On leaves of *Baccharis Douglasii*, Berkeley, Cala., June, 189 W. C. Blasdale.

Spots suborbicular, 3–4 mm. diam., dirty-brown, greenish first, mostly wrinkled. Hyphae hypophyllous, cespitose, hyalin simple, mostly straight and continuous, entire or faintly toothe above, 25–40 x 4 μ. Conidia cylindrical, obtuse at both ends, 1–3 septate, hyaline, 40–60 x 4–4½ μ.

Cercosporella nivosa E. & E.

On leaves of *Pentstemon Digitalis*, Ohio. Morgan, No. 414, and on *P. ovatus*, Idaho. Piper, No. 297.

Spots small, round, 1–2 mm., white, with a narrow slightly raised margin surrounded by a purplish discoloration. Hyphae simple, subattenuated above, nucleate, continuous, 12–15 x μ, long hyaline above, brownish and more or less swollen below, numerous, seated on a hemispherical, cellular, brownish, sphaeriaform base and bearing at their tips the cylindrical, hyaline conidia, 12–25 x 1½–2 μ, nucleate and becoming 1–2-septate.

Differs from *C. Pentstemonis* E. & K., in its smaller hyaline conidia and hyphae, white spots, and narrow, thread-like margin.

Cercospora hibiscina E. & E.

On leaves of *Hibiscus tiliaceus*, Mexico, 1895. Dr. E. Palmer, No. 328.

Hypophyllous. Hyphae sparingly branched, septate, equal, 3½–4 μ

Cercospora Grindeliæ E. & E.

On leaves of *Grindelia* sp. Berkeley, Cala., June 1894. W. C. Blasdale, No. 258.

Amphigenous, scattered in small, more or less confluent patches over both sides of the leaf. Hyphae tufted, short, simple, continuous, 15–35 x 4 μ, subentire, or imperfectly toothed above, subhyaline. Conidia slender-clavate, yellowish-hyaline, granular and nucleate, becoming faintly 3-6-or more-septate, sometimes constricted at one or more of the septa, and often abruptly enlarged at one end, 50–140 x 4–7 μ.

Cladosporium aromaticum E. & E.

On living leaves of *Rhus aromatica*. Pasadena, Cala., August 1894. Prof. A. J. McClatchie, No. 779.

Epiphyllous, scattered, not on any definite spots. Sterile hyphae, scanty, creeping, branched, fertile hyphae scarcely tufted, erect, pale olivaceous, septate and constricted at the septa, subgeniculate, 30–70 x 5 μ. Conidia terminal, concatenate, olivaceous, oblong-cylindrical, uniseptate, not constricted, 12-22, (mostly about 15) x 5 μ.

The hyphae thickly scattered over the surface of the leaf give it a smutty appearance.

Macrosporium toruloides E. & E.

On dead stems of *Urtica Lyallii*. Pullman, Wash., March 1894. Prof. C. V. Piper, No. 320.

Effused, forming a thin, olive-black, velutinous layer for several cm. in extent. Hyphae toruloid, closely septate, branched. Conidia variable, 15–40 x 10–15 μ, 3-6-septate and rather sparingly muriform, the smaller ones sarcinuliform, the larger ones obovate, borne on deciduous, closely septate pedicels 25–45 x 5–5 μ, enlarged above into the conidia.

Both the sterile and fertile hyphae are so closely septate as to resemble threads of *Torula*.

Sporidesmium punctans E. & E.

On bark of living limbs of *Planera aquatica*. St. Laudry, Co., Louisiana, July 1894. Langlois, No. 2,392.

Punctiform, scattered, conidia cespitose, short stipitate, of various shapes, subglobose, 20-30 μ, diam. or often clavate or obpiriform, clathrate-septate, brown, 25–75 x 12–20 μ, including the short, 12-20 μ, septate pedicel.

The tufts of conidia form little black specks, which at a casual glance resemble minute perithecia.

Brachysporium pedunculatum E. & E.

On dead stems of *Sambucus glauca*, Pullman, Wash., March 1894. Prof. C. V. Piper, No. 316.

Tufts punctiform, ½-¾ mm. diam., erumpent and closely bordered by the ruptured epidermis. Sterile hyphae coarse, 6-8 μ thick, branching, sparingly septate, crooked, hyaline, intricately interwoven. Conidia oblong, or the shorter ones ovate, biseptate, but scarcely constricted, brown, borne on short, ovate, brownish basidia 2–15 x 6–8 μ arising from the prostrate hyphae, but finally separating and remaining permanently attached to the conidia.

This agrees with the diagnosis of *B. biseptatum* Sacc. and Roum. only that has dark hyphae ("intense fuligineis") and there is no mention made of the *permanent* basidia so constantly seen in our Washington species.

Macrosporium cucumerinum E. & E.

On living leaves of *Cucumis melo*, Las Cruces, New Mexico, Aug., 1895. Prof. E. O. Wooton.

Epiphyllous, on orbicular, subconfluent, rusty-brown spots, 3–4 mm. diam., becoming whitish in the center. Hyphae fasciculate or solitary, few in a fascicle, subgeniculate, 1–3-septate, 35–50 x 5–6 μ Conidia clavate, slender-stipitate, 3–8-septate, scarcely constricted, submuriform, 30–75 x 15–25 μ, pedicel, 25–35 μ long. Nearly

Stemphylium subradians E. & E.

On bark of dead limbs of *Lonicera involucrata*, "Coffee Pot Springs," Colo., Aug., 1894. Alt. 9,500 ft. Prof. C. S. Crandall, No. 93.

Hyphae decumbent, brown, continuous or faintly septate, 2½–3 µ diam., radiating from scattered points of attachment to the matrix and forming a loose network. Conidia subglobose, 20–30 µ diam., composed of globose, brown cells, 5–8 µ diam., and borne on short lateral branches or pedicels, issuing at a right angle from the prostrate threads. To the naked eye the fungus appears like black, thin, velvety patches indefinitely effused and from 2–10 mm. in extent, often surrounding the limb or twig.

Stilbomyces n. gen. Fam. **Stilbeæ.**

Sterile hyphae creeping, scanty, fertile hyphae united in an erect stipe surmounted by a conidiiferous head composed of bundles of flagelliform, nucleate, conidia. Differs from *Stilbum* only in its conidia.

Stilbomyces Berenice E. & E.

On living bark of *Diospyros*, Pointe Aux Loups, Acadia Co., La., Sept., 1894. Langlois, No. 2,396 and 2,400.

Stipe cinerous-white, 1–1½ mm. long and about 100 µ thick, mostly a little curved, slightly attenuated above, and surmounted by a narrow-elliptical, acute head, a little thicker than the stipe. Conidia flagelliform, hyaline, about 60 µ long and 3½–4½ µ thick at the moniliform-nucleate base, constricted between the nuclei, and finally separating into ovate-elliptical, smoky-hyaline joints, 5–7 x 3–4 µ, prolonged above into a continuous, hyaline bristle like crest which constitutes about half the length of the conidia. These conidia are united at the base so as to form tufts of 50–100 conidia with their flagelliform tips spreading out like the bristles of a paint-brush.

Fusarium acuminatum E. & E.

On living stems of *Solanum tuberosum*, Geneva, N. Y., July, 1895. Prof. S. A. Beach, comm. F. C. Stewart.

Sporodochia gregarious, minute, white at first, then flesh-colored. Conidia falcate, attenuate-acuminate at each end, 3–5, exceptionally 6 septate, not constricted, arising from slightly elongated cells of the proligerous layer, in which respect it differs from the usual type of *Fusarium*. Quite distinct from *F. diplosporum* C. & E., which also occurs on the same host.

OCTOBER 1.

MR. CHARLES MORRIS in the Chair.

Twenty-seven persons present.

A paper entitled "List of Birds collected in North Greenland by the Peary Expedition of 1891–92," by Witmer Stone, was presented for publication.

OCTOBER 8.

MR. CHARLES MORRIS in the Chair.

Nineteen persons present.

Papers under the following titles were presented for publication:

"Archæological Work in Ohio." By Gerard Fouke.

"Certain River-mounds of Duval County, Florida." By Clarence B. Moore.

"Two Mounds on Murphy Island, Florida." By Clarence B. Moore.

"Certain Sand Mounds of the Ocklawaha River, Florida." By Clarence B. Moore.

OCTOBER 15.

OCTOBER 29.

DR. C. NEWLIN PEIRCE in the Chair.

Ninety-one persons present.

A paper entitled, "Synopsis of the North American Species of Gorytes Latr," by Wm. J. Fox, was presented for publication.

The death of Louis A. Harlow, M. D., a member, was announced.

The Publication Committee reported in favor of the publication of the following papers in the Journal of the Academy:

"Certain River-mounds of Duval County, Florida." By Clarence B. Moore.

"Two Mounds on Murphy Island, Florida." By Clarence B. Moore.

"Certain Sand Mounds of the Ocklawaha River, Florida." By Clarence B. Moore.

A preliminary account of the Re-exploration in 1894 and 1895 of the "Bone Hole," now known as Irwins' Cave, at Port Kennedy, Montgomery County, Pennsylvania. MR. HENRY C. MERCER remarked that when Dr. Samuel G. Dixon of the Academy kindly put him in charge of the excavation at Port Kennedy in November of last year, (after Mr. D. N. McCadden, having found fossils in a dump heap, had called attention to the deposit, and after Mr. S. N. Rhoads had excavated there for some time) he, the speaker, soon learned that they were once more at the old so-called "Bone Hole" of Port Kennedy. This was the place referred to by Mr. C. M. Wheatley, who gives a cut of it in the American Journal of Science and Arts for April, 1871, and where he collected the bones described by Prof. Cope in the Proceedings of the American Philosophical Society for April, 1871. A recent lowering of the quarry floor had brought the workmen to the same soft place that they had reached twenty-five years before. They were twelve feet deeper than Mr. Wheatley had been at the previous time, in a gallery filled up with stratified rubbish, whose roof, if it had a roof, had been blasted away, whose bottom had never been reached and whose horizontal extent no one can guess. They were not standing in the darkness under a rock arch, but in the open quarry, forty-five feet below the original surface of the hill, at the very bottom of the quarried area, and below its water level, so deep that the drainage hole close by had to be pumped out day and night to keep the floor dry. A great mass of red talus, unfortunately dumped exactly upon the deposit, overhung them ready to fall as the digging went on.

The explorer was confronted by a vertical bank about twenty-five feet wide by twelve feet high and striped with colored bands of stratification and it was the great number and variety of the bones of animals that protruded from it in all directions that first astonished him. The bones lay in the red clay and black earth with fragments of limestone and bits of shale, broken, crushed, ground into a sort of meal, or flattened by the down-settling of the earth, often oozing full of water like a soaked sponge, and falling to pieces when touched, so that they had to be cased in shells of plaster of paris, to be removed. All that was seen was scattered and dislocated; no skeleton lay together, nor had the marks of gnawing teeth been found upon any of the bones to indicate a den of carnivorous beasts, while the kind and proportion of the remains further dispel the latter idea. The country, which for this reason they might infer was thickly wooded, must have been thickly inhabited by sloths, judging from the astonishing number of their bones, and as inferentially from modern species neither this animal nor the tapir, buried with it, endured cold, the climate was probably warm or temperate. Animals large and small, fierce and gentle, lay together, the cumbrous mastodon whose bones had been ground to powder, or dislocated and crushed, at the bottom of the digging along with the rabbit and the turtle. Professor Cope had shown that there were feline carnivores and abundant bears, and they had found the saber-toothed tiger with the bones of birds and the remains of the gentler horse, the beaver, and the llama. What was the power that destroyed the creatures, and what the event that brought toegther their bones and buried them in one place?

Not to anticipate a description that ought to be, very carefully given of the position and contents of this remarkable deposit, of the way the jaws and the teeth, the knuckles and the vertebræ of these inhabitants of land and water, earth and air lay together, of the for great thick blocks of wood, still undecomposed, cut out of trees, and though rubbed and rounded in an inexplicable manner, still retaining their bark? Aware that he was probably dealing with a situation such as had never before been presented in the sea-board region, and not certain what might be disclosed at any moment, he had taken the most minute care of all the bones that could be saved, labelling everything at once, according to a system of numbered rectangles painted on the deposit with white-wash so that the exact relative position of each specimen could be recorded and a chart made, if need be, to show the whole series in place at a glance.

Here was an immense deal of evidence sealed up, every item of which should offer an important clue to the conditions of pleistocene time. The matrixes sent in bulk in boxes, because they contained too many small remains to be opened at the cave, should be studied by a botanist. There were parts of trees, twigs, and possibly grasses, leaves, vines, fibres, nuts and seeds, all as clearly a part of the time and its climate as the animals.

Several suppositions were necessary to account for what was seen:

First. This diverse and uncongenial horde of animals must have come together, whether to eat salt, feed, drink, cross a swamp and perish in the mire, fall into a hole, or to take refuge at some point of vantage from some terror of nature.

Second. They perished, but how? Should the entombment be referred to wholesale destruction by lightning, carcasses dragged into an open cavern by carnivores, or numbers of animals going to one spot to die? If it was drowning on a large scale, how account for the birds and the turtles?

Third. The flesh decomposing had left the bones, and the bones themselves had decayed in many instances before they were redeposited in the cave. This was certain from the fact that no skeletons lay intact.

Fourth. Water had redeposited the already fleshless and weakened bones in their present position, grinding many of the older and more fragile into a sort of meal, imbedding others comparatively intact in this meal, depositing all in hopeless confusion with clay and stones in stratified bands, and destroying them still farther by the down-settling of the debris after they had reached their present position.

There seemed to be no mixing of epochs or down-washing of old and new deposits into this deep chasm. Whatever else was inferred from the debris they knew its geological date. They had gone back one geological step, into different conditions of species, and a different climate. If they were to find a paleolithic ape-like savage in eastern North America this was the place to settle his antiquity beyond all reasonable doubt. No trace of humanity had yet been found, but if Man were living at this time they might suppose that the waters which gathered together and poured into this tomb so many living creatures seized him also, and that at some unexpected moment, they should find a piece of his skeleton, or a fragment of his handiwork to prove it. Port Kennedy represented the meeting ground between anthropology and paleontology, where perhaps from the point of view of the latter larger science, it was sufficient to gather the bones, and identify the species, but anthropology asked for more. It must have everything measured and in place. On the alert for the sudden apparition of Man, it must know how, when, why, by whom, and under what circumstances all these objects were found. No more of the doubt that beclouded the classic deposits at Natchez, Miss., or Trenton, N. J., that perplexed the student who went to Stockholm and tried to get at the real meaning of the bones that Lund supposed he found associated with pleistocene fossils in the Minas-Geraes Caverns in Brazil. No more of the uncertainty that obscured at first the investigations at Gailenreuth, where pottery and charcoal seemed to be mixed with the bones of the Cave Bear, or at other caverns in Belgium, England and France, where for a long time science concerned itself with the species of animals found, and not with the human remains associated with them. If *Homo sapiens* were found at Port Kennedy the fact and its significance could well be established beyond all controversy, but since Dr. Dixon and the speaker had begun excavation there a year ago, and after working at the spot for more than a month last autumn, and during several recent weeks, the latter felt that it would be safe to say that not one-third of the deposit had been removed, though he himself had dug out about 300 cubic yards, and Mr. Rhoads had removed as much previously.

for 1871. The number of species determined at that time was thirty-four.

The specimens now received were derived from another part of the same fissure, which had been exposed by further excavations by the quarrymen. The first to come to hand were obtained by Dr. Dixon and Mr. S. N. Rhoads, but subsequently a large amount of material had been taken from the deposit by Mr. H. C. Mercer, who had carefully noted the position of every specimen. The observations now made by Prof. Cope were based on not more than half the material obtained, and could be regarded as only preliminary to a full report which he hoped to make at a future time.

The species obtained so far, including those of the collection of 1870, are as follows: *Batrachia*, undetermined, one sp., *Testudinata*, three species; *Ophidia*, two species; *Aves*, two species; *Mammalia*, *Edentata*, five species; *Glires*, twelve species; *Insectivora*, one species; *Carnivora*, fourteen species; *Proboscidia*, one species; *Diplarthra*, seven species; total, forty-eight species. Subtracting three species from the list of 1871 as not well founded, we have an addition of seventeen species made by the present exploration. Of these additions ten species are Carnivora.

Characteristic peculiarities of the association of species are the following: The most abundant of the large mammals is the tapir, *Tapirus haysii* Leidy. The next most abundant is the bear, *Arctotherium pristinum* Leidy. Probably the skunk, *Mephitis mephitica* L. is the next most numerously represented. If we regard the sloths of the genus *Megalonyx* as representing one species, they are the most numerous in individuals, but there are several species. *Equus major* Dek. and *Mastodon americanus* Cuv., in both young and adult individuals, are not rare. The remains of *Elephas* have not been found, and the first collection only contains *Mylodon*. Peccaries of two species are not uncommon; while a few individuals of a deer occur, and a single tooth of a rather large cameloid. The Glires of the new collection had not been investigated, but there is a left ramus mandibuli of a beaver which is very near to, if not identical with, the *Castor fiber*, a species not contained in the collection of 1870. No fragments of opossum have been found, and raccoon is very rare.

More attention has been given to the Carnivora of the collection. The *Arctotherium pristinum* is of South American type, and is widely different from the existing North American bears. Associated with it are remains not distinguishable from the common black bear, *Ursus americanus*. A few teeth and bones are not distinguishable from those of the wolf, while two species of foxes are represented by two molar teeth, one of which is not distinguishable from the corresponding part of the gray fox, *V. cinereoargentatus*. Fragments of sectorials are closely similar to those of *Bassariscus astutus*, and fragments represent a weasel, *Mustela*. The cats are represented by four species, of which the most abundant is the red lynx, *L. rufus*. There is a smaller cat represented by mandibular ramus, which resembles in characters and in size the corresponding parts of the eyra, with which it seems to be identical. There are three inferior premolars, and perhaps a part of a superior sectorial of a cat of the size of the jaguar, which appears to be new to science; and there are several teeth and a part of the lower jaw with teeth, of the large saber-tooth which has been called *Smilodon gracilis* Cope. Finally a lower sectorial and a premolar indicate an ally of the hyænas; which is described below as *Crocuta inexpectata*. The following are the descriptions of the new forms:

UNCIA MERCERII sp. nov. This species is represented by three premolar teeth of the lower jaw which belong to two individuals. The posterior part of a superior sectorial tooth accompanies these remains, and may belong to the same species. These teeth belong to an animal of the dimensions of the jaguar, and the inferior premolars have the posterior heel and lobe, and anterior basal lobe, well developed. The horizontal section of the principal cusp is lenticular, without much difference in the degree of convexity of the outlines. The teeth differ from those of both the jaguar and puma in the greater elevation of both the posterior heel and lobe, which are separated from each other by deep incisions. The posterior part of the crown is narrower posteriorly, especially in the anterior tooth, which differs more in all the points mentioned than does the posterior tooth. Enamel smooth. Length of crown of p. m. I, 21 mm; width of do. posteriorly 9 mm.; elevation of do. 14 mm. Length of crown of p. m. II, 16 mm.; width of do. 7.5 mm.; elevation of do. 8.5 mm. This species is smaller than the *Uncia atrox* Leidy, which equals the lion, and which differs also in the much simpler character angular process, but has no distinct apex; its base displays the origin of a separate root. The inferior sectorial has no trace of heel. The first premolar is short and robust, and has a short but well-defined heel, and well-marked but not elevated posterior lobe. The principal cusp is elevated and robust, with lenticular section with outlines of very unequal convexity. In a probable second specimen of this tooth, the anterior lobe is distinct, acute edged, and little elevated. Incisors short, hooked, and with basal lobe at one side only.

The length of the fragment of the superior canine measures 111 mm.; anteroposterior diameter at base of crown 27 mm.; do. at 30 mm. from base 24 mm.; transverse diameter at do. 11 mm. Anteroposterior diameter of superior sectorial 31 mm: greatest width (at protocone) 14 mm. Anteroposterior diameter of inferior sectorial, 23 mm.; do. of p. m. I. 20 mm. (restored).

This species differs from the *S. floridanus* Liedy, in the much greater compression of the superior canine tooth, while the general dimensions are similar.

CROCUTA INEXPECTATA sp. nov. This species is represented by a right inferior sectorial in good preservation. It resembles a good deal that of *Crocuta maculata*, and agrees with it in the absence of trace of metaconid. The cutting heel is rather longer than in that species, and the cingulum which is so conspicuous in it is wanting in the fossil tooth. The paraconid and protoconid are well elevated and equal. Anteroposterior diameter of crown 24 mm.; do. of do. exclusive of heel 19 mm.; elevation of paraconid 10 mm.

The occurrence of a hyena in this collection is unlooked for, but was rendered less incredible by the discovery of a species of this family, *Borophagus diversidens*, in the pliocene bed of Texas. There is an alternative to the identification of this species as *Crocuta*, and that is that it might belong to the genus *Nimravus*. As this genus belongs to the middle Miocene, it is extremely improbable that it should have a representative in the Pleistocene fauna, although the survival of this form of sectorial tooth in connection with modern feline characters in other respects is not an impossibility.

Of the forty-eight species contained in the collection eleven have not been finally determined. Of the thirty-six determined species nine, or twenty-five per cent., are still existing, and the remaining twenty-seven are extinct. Of the existing species eight are nearctic, and one, *Felis eyra*, is neotropical. Of the extinct species ten are of nearctic type, and ten are of neotropical type; the remaining six species being indifferently one or the other, except the *Crocuta*, which is of old world type. The presence of *Equus major*, and of the beaver, connects the fauna directly with that of the Equus beds of the West and Southwest, with which the Megalonyx fauna, as he had called this one, was probably contemporaneous. These faunas were separated by a long interval of time from the later ones whose remains, including those of Man, have been found in so many caves by Mr. H. C. Mercer. The speaker had suggested[1] that this interval was marked by the Champlain depression during which the Columbia gravels and other formations of gravel and clay were deposited, and he had hence designated the caves of the two ages as Prechamplain and Postchamplain.

As regards the mode of occurrence of the remains of this fauna the following remarks were made. No single cave deposit has been found as yet which contains so large a number of species as the subject of this communication, although those of Brixham in England and Gailenreuth in Bavaria, contained as many or more numerous individual animals. As the majority of the species at Port Kennedy are not cave-dwellers, and many of them, as the mastodons and sloths, cannot well have been dragged there by carnivorous species, the question arises as to how the accumulation came about. The bones show no signs of gnawing, nor of wear, as though they had been transported. At the same time two bones have been rarely found in their normal relations in the skeleton. The fissure has been exposed for some twenty feet from the summit, but the bottom has not been reached, chiefly on account of the quantity of water present. The scattered and mixed relations of the bones are identical with the conditions he had found to exist in caves containing the same fauna in Southwest Virginia and East Tennessee. No local conditions will therefore account for a phenomenon so widespread.

Without evidence of a conclusive character, the impression which he had gathered from the facts is as follows: He suspected that the larger animals at least fell into this fissure during a long period. Many of the smaller ones may have entered it from entrances now filled by debris. Animals frequently resort to caves to die. A gallery of fifty feet in length which is large enough to admit a man standing nearly erect, in the Marble cave in South West Missouri, was found to be packed for a considerable part of its length by mummied raccoons who had apparently crawled in there. At the period of submergence of the Champlain epoch, floods of water from melting ice poured into the fissure, and filled it to the mouth with debris, churning up the contents already there, and carrying in logs and other vegetable matter. The stratification of the deposit may be thus accounted for, as also the presence of worn and unworn stones. In the lower part of the deposit vegetable debris and forest mold predominate, which contain seeds and nuts. This deposit apparently represents the long period during which the fissure was open.

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[1] American Naturalist, 1895, p. 598.

The Port Kennedy Deposit. PROF. ANGELO HEILPRIN, commenting upon the evidence that had been submitted regarding the age of the deposit, believed that special caution was necessary in assigning to the debris a definite geological position. To him the large number of extinct or Neotropical forms indicated more nearly a Pliocene rather than Post-Pliocene fauna—at all events a fauna whose culmination preceded the Glacial Epoch—and he was hardly prepared to accept them as a part of the fauna of the region which survived the melting of the ice. The correspondence was with the Pampean fauna of the southern continent, and this he was also inclined to believe to be (as Prof. Cope himself had years before announced) Pliocene. Prof. Heilprin said that he was not yet a convert to the Columbian gravel theory, regarding which far too much uncertainty existed to permit it to be accepted as a broad chronological element in geological history. He thought it not unlikely that the remains in question had been subjected to redistribution by the glacial flood of the Delaware River Valley, the high backwater of which must have penetrated far into the valley of the Schuylkill, and into the very region of Port Kennedy.

The Recording Secretary read the following:—

A BIOGRAPHICAL NOTICE OF W. S. W. RUSCHENBERGER, M. D.

BY EDWARD J. NOLAN, M. D.

Since the first recorded meeting of the founders of the Academy, "friends of science and of rational disposal of leisure moments" at the house of John Speakman, January 25, 1812, the society has been served by a succession of devoted men who have given their time, their means and their best thought to the promotion of its interests. The membership at large, however, has been for the most part composed of specialists in science who have had neither time nor inclination to occupy themselves with administrative affairs, and a much larger number who have been content to lend their support, moral and pecuniary, to an institution for the advancement of learning without taking part intimately in the details of its work.

The services rendered by the subject of this notice during the last twenty-six years of his life are of such character and magnitude that they have secured for him a distinguished position among the benefactors of this society. He was intellectually in close sympathy with the Academy's work, while the termination of his active connection with the United States navy enabled him to devote himself with tireless fidelity to the duties of the several executive positions in which he was placed.

WILLIAM SAMUEL WAITHMAN RUSCHENBERGER was the son of Peter Ruschenberger, a sea captain, and Ann Waithman. His mother, the third in a family of nine children, was born near Bridgeton, Cumberland Co., N. J., June 18th, 1785. Her son was also born there September 4, 1807. Prior to this, however, her father and his family had moved to Philadelphia, the young couple living with them, and here a daughter was born. Three months before the birth of the son Captain Ruschenberger and all his crew were lost at sea, leaving the wife and children in straitened circumstances, so that it became necessary to add to their income by literary work. Sacrifices were made to secure a good education for the boy, who co-operated earnestly with his mother to that end. The details of his early training are not known, but he attended schools in New York and Philadelphia, and studied Latin with an Irishman of culture who had been compelled to leave the country of his birth for political reasons. The pupil declared more than half a century later that his teacher's bitter denunciation of English injustice had permanently influenced his political opinions. Other particulars of his early life are wanting.

He was appointed to the United States navy from the State of New Jersey, August 10, 1826, when not quite nineteen years of age. He entered the service as surgeon's mate, his first cruise being on the U. S. S. Brandywine of the Pacific Squadron. His fitness secured for him the position of commodore's secretary, in which capacity he served under Commodore Jacob Jones during 1828 and 1829. He had, in the mean time, matriculated in the Medical Department of the University of Pennsylvania from which institution he received his degree of Doctor of Medicine, March 24, 1830.

He was commissioned as Surgeon in the Navy, April 4, 1831, and was assigned to the sloop Falmouth, also of the Pacific Squadron, on which he served from June, 1831 to February, 1834. As a result of this voyage he published in Silliman's Journal for 1831 and 1833 a translation of a paper by Dr. C. Bertero entitled, "A List of the Plants of Chili." This appears to have been his earliest contribution to science.

On his return home he published in 1834 his first important work under the title, "Three Years in the Pacific." In the prefatory note the author states that he has "avoided obtruding himself upon the attention of the reader and has indulged in but few reflections, being content to present naked facts and allow each one to dress them for himself and draw his own conclusions." This statement characterizes the work with a fair degree of accuracy. The social and political life of Brazil, Chili, Bolivia and Peru are described with animation, the style, especially in the earlier chapters, being diffusive and somewhat florid, rather sharply contrasting with the somewhat sententious diction of his later work. There is a youthful sparkle and sense of humor in his descriptions of persons and incidents, which, in spite of the fidelity with which he adheres to the promise of his preface, make the book a charming narrative of adventure. The young surgeon, moreover, evidently regarded it as his duty to convey as much solid information as possible, and geographical, political and sociological notes, bearing the stamp of accuracy, are not wanting. A characteristic abhorrence of sham and pretence is manifest throughout the book, while the religious opinions and practices of the people are referred to with respect and courtesy, although, as was inevitable, with plainly expressed dissent. The friends of the young author surely had reason to be satisfied with his first literary offspring.

He was Fleet Surgeon on board the U. S. S. "Peacock" of the East Indian Squadron from 1835 to 1837. This cruise resulted in his second work, "A Voyage Round the World, including an Embassy to Muscat and Siam in 1835, 1836 and 1837." The volume bears the date 1838 and is dedicated to Dr. Samuel George Morton, then Corresponding Secretary of the Academy, of which Dr. Ruschenberger had been elected a correspondent in 1832. He was transferred, in compliance with the By-Laws, to the class of active members on his taking up his residence in the city.

The superb opportunity of acquiring a knowledge of portions of the world not then known nearly as well as they are now had been improved to the utmost. Besides the journal of an embassy from the Government of the United States to the courts of Muscat, Siam and Cochin-China the work embraces sketches in Zanzibar, Arabia, Hindostan, Ceylon, Java, Siam, Cochin-China, China, the Sandwich Islands, Mexico and California. The style, although matured, is bright and animated, and the broad spirit of toleration and fairness of the earlier work is maintained. A growing fondness for natural history and an increased familiarity with the characters of animals and plants are also evident.

contribution to the latter being specimens of Chiton, supposed to be new species, from Chapman's Island.

It was probably during this period that he prepared the text-books of natural history which subsequently appeared under the following titles:—

Physiology and Animal Mechanism, 1841.

Mammalogy. Natural History of Mammiferous Animals. 2nd Book of Natural History, 1842.

Mollusca. Elements of Conchology, 1843.

These works were from the text of Milne Edwards and Achille Compte, and were the first of a promised series which was not, however, continued.

A Lexicon of Terms in Natural History, 1850.

Elements of Natural History, embracing Zoology, Botany, and Geology. Two volumes, 1850.

More than one member of the Academy has acknowledged his indebtedness to these text-books for his first knowledge of natural history. They are purely technical and possess no literary grace other than that of clearness and directness of statement.

He served at the Naval Hospital, Brooklyn, from 1843 to 1847, and while there organized the Naval Laboratory for supplying the service with pure drugs and reliable instruments. This establishment is said by his contemporaries to have been much needed and to have especially proven its usefulness during the trying period of the civil war. About this time he published a number of pamphlets on the relations of the medical corps to the United States Navy with a view to securing proper definition of authority, rank, responsibility, etc.

He was again Fleet Surgeon of the East India Squadron from 1847 to 1850. Some of his observations during this cruise were embodied in a series of papers contributed to the Southern Literary Messenger for 1852 and 1853. They were issued later in book-form under the title "Notes and Commentaries during a Voyage to Brazil and China in the year 1848." As might be expected from the mode of publication, the work has not the sustained interest or value of his other volumes of travel. It is discursive and disjointed, although still bright and instructive.

On his return to America he was assigned to duty in Philadelphia, and immediately resumed his active connection with the Academy.

He served as a member of the Publication Committee from 1851 to 1854, and in September of the earlier year, he was appointed to prepare a new and extended notice of the Academy. That he lost no time in the performance of the work assigned to him is evident, for the notice was read to the meeting of February 10, 1852, a vote of thanks being then adopted and communicated to the author through a committee consisting of Messrs. Vaux, Bridges and Pearsall. The paper was published under the title "A Notice of the Origin, Progress, and Present Condition of the Academy of Natural Sciences of Philadelphia." A second edition was issued in 1860.

He served as Fleet Surgeon of the Pacific Squadron from 1854 to 1857.

In January, 1858, a committee of Academicians was appointed to confer with one from the Biological Society with a view to a union of the two bodies. The report was evidently written by Dr. Ruschenberger. The question of Sections is carefully considered in view of the character of the Academy's work, which up to that time, had been almost entirely confined to the study of objective natural history, the recording of specific differences and resemblances of form, classification, and geographical distribution, while the province of the Biological Society was declared to be the discovery of the laws of organic life, the forces which bring together the primary organic cells and the results of their combination. The necessity of providing for organized special work was insisted on, and the alteration of the by-laws to permit of the erection of classes or departments was

Surgeon, in the Mediterranean. This was his last period of service on ship-board. He never again had occasion to go abroad; indeed even short trips from Philadelphia were hereafter of infrequent occurrence. During the summer vacations when nearly all his associates were absent from the city he remained at home, declaring that the shady side of Chestnut Street was the most desirable summer resort known to him.

During a portion of the period of the civil war, from 1861 to 1864, he was stationed at the Boston Navy Yard, where, in common with everyone connected with the public service he found himself charged with most engrossing duties.

He was on special duty again in Philadelphia during 1865 and 1866 when his attention was professionally occupied with the affairs of the Naval Hospital. He also discharged the duties of President of the Board of Examiners with which he had before been connected as a member. In the American Journal of Medical Sciences for July, 1867 he published a paper entitled "Contributions to the Statistics of Human Growth" based on an examination of 217 candidates for admission to the Naval Academy at Annapolis.

He was retired on age in 1869 with the rank of Surgeon, being later promoted to the grade of Medical Director, with the relative rank of Commodore, as a special recognition of long and efficient service.

While relieved from the performance of professional work in connection with the United States Navy he was far from availing himself of the opportunity to rest, or acknowledging the necessity of doing so. He found himself physically and mentally as vigorous as he had been for the past twenty years with every prospect of a long life. His mother lived until ninety-eight years old. It was now that his active connection with the Academy, the American Philosophical Society and the College of Physicians was productive of the most lasting results.

On the organization of the Board of Trustees of the Building Fund of the Academy in 1867 he had been chosen President thereof, and from that time until his death, while the work of collecting subscriptions was in progress and later during the erection of the buildings, he was indefatigable in the discharge of the duties of this position. The work accomplished is set forth in the fourteen elaborate published reports prepared by him. They cover the operations of the

Board from 1867 to 1878 and during 1890, 1891 and 1892, the history of the inactive intermediate years having been left by him fully recorded in manuscript. In support of this enterprise he published in 1871 an address on the claims of the Academy to public favor, in the Penn Monthly for November 1873 an article on the value of original scientific research and, on the occasion of the removal of the Academy to the new building, a report to the contributors on the condition of the society at that time, together with numerous replies, statements and appeals in the newspapers. The buildings of the Academy are, in truth, whether regarded as meritorious or faulty, the visible evidence of Dr. Ruschenberger's zeal, industry and perseverance and the memorial, if one were to be assigned him, most consonant with his tastes and desires.

He was elected one of the Vice-Presidents of the Academy in January, 1869, to fill the position rendered vacant by the death of John Cassin. At the annual meeting of the same year he was elected to the highest position in the gift of the society which he held until 1881 when, having declined a renomination, he was succeeded in the Presidency by Dr. Joseph Leidy.

From 1876 until the close of his service as President, Dr. Ruschenberger presented a series of reports at the annual meetings of the Academy reviewing the work of the society. In the first report thus presented he defines his attitude towards the department of instruction, provision for which had been incorporated in the new code of by-laws just then adopted. He gives emphatic endorsement to the idea of gone, when we can no longer have a voice in its management, and under theories of administration entirely different from ours, so that it is wise to enforce our own views if we can, but if not, to help along as far as practicable, the views of the dissenters."

A minute of appreciation and regret was adopted on his declining a renomination for the Presidency. His executive work in the Academy did not, however, cease. He became a member of the Council almost immediately and he was elected a Curator in 1882. On the death of Dr. Leidy in April 1891, he became Chairman of the Board of Curators, which position he held during the rest of his life. His services as Councillor were invaluable because of his retentive memory and his accurate knowledge of Academy traditions and history during nearly half a century.

He served on the Publication Committee from 1872 to 1878 and on the Library Committee from 1873 until his death.

He was Director of the Conchological Section continuously from 1869, the year of its formation, and of the Botanical Section from 1876 to 1894. He also served terms as Director of the Biological and Microscopical Section and as Vice-Director of the Mineralogical and Geological Section. Until incapacitated by failing health he was rarely or never absent from the meeting of these bodies while officially connected with them.

Although he devoted the greater portion of his time to the affairs of the Academy they did not absorb his entire attention. He became a member of the College of Physicians of Philadelphia in March 1836, was Vice-President from May 1875 to May 1879 and President from May 5, 1879 until January, 1883.

He was elected a member of the American Philosophical Society October 17, 1849. The high appreciation in which he was held by his fellow-members is shown by the fact that he was annually re-elected to the Vice-Presidency of that Society from January, 1885. His services to these societies have been recounted in biographical notices specially prepared for them and need not be dwelt on here.

The following is a list, probably incomplete, of other societies to which Dr. Ruschenberger belonged, with the dates of his election:

County Medical Society of Philadelphia, March 24, 1831.
United States Naval Lyceum, New York, February 1, 1836.
Franklin Institute, April 15, 1840.
College of Physicians and Surgeons of New York, Feb. 22, 1845.

American Institute, New York, June 13, 1845.
Military Order of the Loyal Legion, October 20, 1836.
Pennsylvania Horticultural Society, March 16, 1886.
Pennsylvania Zoological Society, October 13, 1887.
Philadelphia College of Pharmacy (honorary), March 27, 1893.

In addition to the literary work heretofore noted he prepared and published in connection with the Academy, the College of Physicians and the American Philosophical Society biographical notices of the following persons:—

Charles Pickering, M. D. Proc. Acad. Nat. Sci. Phila., 1878.
William S. Vaux. Proc. Acad. Nat. Sci. Phila., 1882.
Robert Bridges, M. D. Proc. Acad. Nat. Sci. Phila., 1882 and Proc. Am. Phil. Soc., XXI, 1884.
Thomas Stewardson. Trans. Col. Phys. Phila., 1884.
George Fox, M. D. Trans. Col. of Phys. Phila., 1884.
Robert E. Rogers, M. D. Proc. Am. Phil. Soc., XXII, 1885.
George W. Tryon, Jr. Proc. Acad. Nat. Sci. Phila., 1888.
Caspar Wister, M. D. Trans. Col. Phys. Phila., 1890.
Gouverneur Emerson, M. D. Proc. Am. Phil. Soc., XXIX 1891.
Joseph Leidy, M. D. Proc. Am. Phil. Soc., XXX, 1892.
William B. Rogers. Proc. Am. Phil. Soc., XXXI, 1893.
William V. Keating, M. D. Proc. Am. Phil. Soc., XXXIII, 1895.

These notices were all characterized by accuracy of detail and, for by an annoying bronchial affection, which, added to the infirmities of advanced age, rendered it imprudent for him to encounter variations of temperature. While thus prevented from giving the usual attention to his official duties, his time was congenially occupied in correspondence, composition and study, no diminution of mental clearness or activity being apparent to the friends whom he greeted so cordially. During the late winter his vital powers gradually but steadily failed, until after six hours of unconsciousness the close of his busy and useful life was reached, calmly and without acute suffering, March 24th, in its eighty-eighth year.

Dr. Ruschenberger was a man of striking individuality. The dominant notes of his character were loyalty to truth, as he understood it, and unsparing devotion to duty. His prejudices were strong and his affections warm. He was a strict disciplinarian, but he never exacted from others what he was not prepared to render himself. He was frequently severe in his criticisms, which were, however, in the main salutary. While assuming a stern demeanor to those whom he thought deficient in a sense of duty, to the earnest student he was always helpful and encouraging. To those who knew him intimately, his innate gentleness was apparent, an affectionate word or a kindly proffer of assistance, especially during his later and less robust years, at once eliciting evidence of grateful emotion. He was impatient of what he called "indirection," preferring on the part of others the frankness which he was not afraid to employ himself.

His æsthetic tastes were austere in the extreme. He cared but little about art as such, and the utter absence of ornamentation from the interior of the museum and library of the Academy is due to this peculiarity of the Chairman of the Board of Trustees of the Building Fund rather than to economic necessity. He once remarked that had he his way he would pull down to a level with the house tops, all the church steeples, as they were unsightly and useless. Whether this feature of his character was due to inheritance, to education or to long association with an environment where the refinements of ornamentation would be out of place cannot be determined. His attitude toward literature was equally severe. He regarded the matter-of-fact narrative of "Robinson Crusoe" as the ideal novel, while the glowing imagery of Pierre Loti's "An Iceland Fisherman" was pronounced "unreadable stuff."

He had, however, that precious endowment, a well devolped sense of humor. His conversation was frequently enlivened by the relation of laughter-provoking incidents from his wide and varied experience, while the good things related by others were heartily enjoyed by him.

A friend having asked him shortly after his eighty-third birthday what he had learned of most value during his long life, he replied after a moment's reflection, "Well, I believe I have learned not to be too cock-sure of anything."

The official who endeavors to perform his duty without fear or favor is certain to antagonize the ignorant, the selfish, and the unscrupulous as well as those holding honestly different opinions. This is equally true of the officer of a society, the chairman of a committee or a Metropolitan police commissioner. Dr. Ruschenberger was no exception to the rule. When convinced that he was right he was, notwithstanding his tolerant theories, but little disposed to make concessions, sometimes holding tenaciously to his opinions even in the face of an adverse decision by the majority. Hostile critics were therefore not lacking, but he was probably consoled by the reflection that "he who never had an enemy was never worthy of having a friend." Friends, steadfast and warm, he had; friends to whom he had endeared himself by his sterling qualities of heart and mind.

While he treated the religious opinions of others with toleration and respect, he left his own to be inferred. He certainly was not in visible union with any recognized form of orthodoxy, and would

CONTRIBUTIONS TO THE ZOOLOGY OF TENNESSEE,
No. 2. BIRDS.

BY SAMUEL N. RHOADS.

It has been thought desirable not only to include in the following annotated list of the avifauna of Tennessee a synopsis of the species observed during my recent trip, but to make it comprehend all the birds of which we have any record as now inhabiting or formerly occurring in the State.[1]

I have consulted, among others, the following references, which constitute nearly all the literature relating to the birds of Tennessee that has come under my notice.

Wilson, A.; American Ornithology, 1810–11.

Ord, G.; Sketch of Life of Alex. Wilson, 1828.

Fox, W. H.; Stray Notes from Lookout Mountain, Tennessee; Bull. Nutt. Orn. Club, VII, 1882, p. 191.

Fox, W. H.; Birds of Roane County, Tennessee. Auk, III, 1886, p. 315.

Lemoyne, ——; Notes on Birds of the Great Smoky Mountains, Tennessee. Orn., Oologist XI, 1886, pp. 115, 131, 149, 163, 179.

Langdon, F. W.; August Birds of the Chilhowee Mountains, Tennessee. Auk. IV, 1887, p. 133.

Hasbrouck, E. M.; On the Ivory-billed Woodpecker and Carolina Paroquet. Auk, VIII, 1891, pp. 183, 378.

Dr. C. Hart Merriam has generously given me free use of manuscript notes on the birds observed by him in the valley of the Little Tennessee, opposite Chilhowee Mountain, July 29, 1887; also his notes on the birds observed at Athens, McMinn County, July 23 to 27, 1887.

In my quotations from these and from the papers listed above I have only made use of such notes as would be of value in supplementing or confirming my own, not undertaking to make the references compendious save for rare or little known species.

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[1] The reader is referred to the first paper of this series, pages 376 to 332 of the Proceedings, for an itinerary of the author's trip through Tennessee and a brief synopsis of the zoo-geography of the State.

For a most valuable and interesting series of notes from West Tennessee I am indebted, to my correspondent, Mr. Benjamin C. Miles, of Brownsville, an old resident, acute observer of nature and enthusiastic sportsman. Through his generous efforts I am able to put on a satisfactory basis the status of several birds which must otherwise have been omitted from this list, and can present several facts relating to the history of bird extermination in that part of the Mississippi Valley, which are of great interest. It is my hope that this paper, the first attempt to give the public a resumé of the ornithology of a long neglected commonwealth, may inspire her people to a desire for something better in this line of educational work.

The entire collection of Tennessee birds brought back to the Academy only numbers sixty skins, no attempt being made to secure any but the rarest species, or others for purposes of identification. The names of species of which there are specimens in this collection are preceded by an asterisk.

The whole number of species and subspecies given in the following list is 214. Of these 10 are of doubtful record or identity, although they all belong to the Tennessee fauna.

Dr. Fox's list records 116 species and subspecies of Tennessee birds. To this add 10 species recorded by Lemoyne, viz.: *Accipiter velox*, *Aquila chrysaëtos*, *Falco peregrinus anatum*, *Pandion haliaëtus carolinensis*, *Syrnium nebulosum*, *Vireo solitarius alticola*, *Helmin-*

Order PYGOPODES.

Family PODICIPIDÆ.

Genus COLYMBUS Linnæus.

1. **Colymbus holbœlli** (Reinh.). Holbœll's Grebe.

A bird which I found lying on a stump in Reelfoot Lake almost certainly belonged to this species. It had evidently been laid there by a gunner the previous winter and was in a badly decomposed state, but the long, slender bill and large size were characteristic enough for identification.

Genus PODILYMBUS Lesson.

2. **Podilymbus podiceps** (L.). Pied-billed Grebe.

Observed at Samburg. It is not unlikely that they breed in that region.

Family URINATORIDÆ.

Genus URINATOR Cuvier.

3. **Urinator imber** (Gunn.). Loon.

Mounted specimens were seen on several occasions, some of which were undoubtedly taken in the State, though I did not take pains to verify the occurrence. Owing to the absence of lakes or ponds in the loftier eastern mountains it is not probable that the Loon breeds anywhere in Tennessee. Lauderdale and Haywood Counties, in winter, B. C. Miles.

4. **Urinator lumme** (Gunn.). Red-throated Loon.

I am under the impression that a pair of this species, in the possession of Mr. Schmidt of Memphis, were taken in the State, but as a number of birds in his collection were brought from a locality in Arkansas on the opposite side of the Mississippi, the record is doubtful.

Order LONGIPENNES.

Family LARIDÆ.

Genus LARUS Linnæus.

5. **Larus argentatus smithsonianus** Coues. Herring Gull.

Mounted specimens in Memphis. Reports of a large gull at Reelfoot Lake during spring migration must refer to this bird.

It winters along the Mississippi below St. Louis. Mr. Miles refers to a gull which he has seen on the Mississippi, "size of a pigeon with very long wings," which probably refers to the Ring-billed Gull *L. delawarensis.*

Family RYNCHOPIDÆ.

Genus RYNCHOPS Linnæus.

6. **Rynchops nigra** (L.). Black Skinner.

A specimen was found dead in Obion County after a severe storm by Mr. J. A. Craig, who gave me an account of it.

Order STEGANOPODES.

Family ANHINGIDÆ.

Genus ANHINGA Brisson.

7. **Anhinga anhinga** (L.). Snake Bird, Anhinga.

This bird is found about Memphis and it is probable that it it occurs on Reelfoot Lake, though I was unable to identify it among the numerous "Water-turkeys" frequenting the Lake, that name being applied to both this species and the Cormorant. There is a Cypress swamp about four miles from Samburg across the lake in which a "Turkey Roost" has existed for a long period, but which has been practically abandoned because of the destruction of the young birds, for bait, by the fishermen. The nests are built in the tops of the tallest cypresses and this fact seems to prove pretty conclusively that the Anhinga bred there, though it is not impossible that the Cormorants have adopted the same rookery and nesting sites in preference to their usual habitations among the

Family PELECANIDÆ.

Genus PELECANUS.

10. **Pelecanus erythrorhynchos** (Gmel). White Pelican.

Seen occasionally along the valley. A mounted specimen shot at Samburg, in the possession of a hotel keeper in Union City, was examined.

Order ANSERES.

Family ANATIDÆ.

Genus MERGANSER Linnæus.

11. **Merganser americanus** (Cass.). American Merganser.

Two were seen on the lake near Samburg. This and the Red-breasted are probably included in Mr. Miles "Shelldrake" records for Haywood and Lauderdale Counties.

Genus LOPHODYTES Reichenbach.

12. **Lophodytes cucullatus** (L.). Hooded Merganser.

One seen on Tennessee River near Chattanooga. It most likely breeds in the State. Probably one of the three kinds of "Summer Ducks" mentioned by Mr. Miles as breeding in trees in Haywood County is this species.

Genus ANAS Linnæus.

13. **Anas boschas** L. Mallard.

Abounding in winter in the Mississippi Valley. Haywood and Lauderdale Counties; Miles. Memphis and Reelfoot Lake; gunners.

14. **Anas obscura** Gmel. Black Duck.

Mounted specimens at Memphis. Haywood and Lauderdale Counties; Miles.

15 **Anas discors** L. Blue-winged Teal.

A flock of eight fed regularly in a little slough near Samburg during my sojourn there.

Other pairs were seen on the lake and it is possible they were summer residents. Roane County, migrant, Dr. W. H. Fox. Haywood and Lauderdale Counties; Miles.

16. **Anas carolinensis** Gmel. Green-winged Teal.

Reported to me by the gunners. Stuffed specimens seen at Memphis. Haywood and Lauderdale Counties; Miles.

17. Anas strepera L. Gadwall.

Mounted specimen at Memphis. This is evidently the duck "No. 2," to which the following allusions are made by Mr. Miles: "As to Summer Duck [there are] 1 Wood Duck; 2 [a duck] said to nest on ground, seen here [Haywood County] at all seasons—size of Teal; male and female very similar, marked like female Mallard; heard them called young mallard—seen and shot them myself for forty years; barely fit to eat."

18. Anas americana Gmel. Baldpate.

Mountain specimens examined, presumably from near Memphis. Haywood County; Miles. This name is also applied to the Buffle-head. Mr. Miles does not think he ever saw the true Baldpate.

Genus **SPATULA** Boie.

19. Spatula clypeata (L.). Shoveller.

Specimen in Mr. Schmidt's collection. Remains of one at Samburg. "Killed one several years ago," Miles.

Genus **DAFILA** Stephens.

20. Dafila acuta (L.). Pintail.

Likewise found in Mr. Schmidt's collection of mounted game. Haywood and Lauderdale Counties; Miles. A female killed the first week in March, 1887, by Mr. Miles, contained a fully developed egg.

Genus **AIX** Boie.

25. Aythya affinis (Eyt.). Lesser Scaup Duck.

One found dead at Samburg.

26. Aythya collaris (Donov.). Ring-necked Duck.

Under the name, "Fall Duck," Mr. Miles contributes the following notes: "Only seen September to November or December; for eating excelled by none save partridge [Duck]. In the fall of 1875 killed about thirty on different hunts—have not seen it in ten years." The name "Fall Duck" is also applied to this bird in Minnesota. I think Mr. Miles has confounded it somewhat with the Canvasback.

Genus GLAUCIONETTA Stejneger.

27. Glaucionetta clangula americana (Bonap.). American Golden Eye.

Mr. Miles sent me a description of one of these Ducks, which he killed several years ago near Brownsville. Since then he verified his identification by the figure and description of this species in Mr. Chapman's book, Birds of Eastern North America. It may be stated that other species, whose identification rests on Mr. Miles' authority, have been confirmed by him in the same manner.

Genus CHARITONETTA Stejneger.

28. Charitonetta albeola (L.). Buffle Head.

Specimens in mounted collection of Mr. Schmidt. This bird, Mr. Miles informs me, is called "Baldpate" by the gunners in his region.

Genus CLANGULA Leach.

29. Clangula hyemalis (L.). Old Squaw.

Respecting this species Mr. Miles says: "Have seen once."

Genus ERISMATURA Bonaparte.

30. Erismatura rubida (Wils.). Ruddy Duck.

Mounted specimens examined. Mr. Miles describes the "Partridge Duck," by which name alone it is known to the gunners of West Tennessee. This name is not to be found in Trumbull's book. Mr. Miles has killed them in Haywood and Lauderdale Counties in February, November and December, and says: "Not common here at any time, but always known." In a subsequent letter he fails to identify his "Partridge Duck" with this or any other species described in Mr. Chapman's Ornithology. I continue to think, however, that it is the Ruddy Duck.

Genus CHEN Boie.

31. Chen hyperborea? Snow Goose.

A Snow Goose, presumably the lesser variety, was seen during the winter of 1893–94, in Haywood County, by Mr. B. C. Miles. It remained there all winter in the company of a flock of Canada Geese.

Genus BRANTA Scopoli.

32. Branta canadensis (L.). Canada Goose.

Soon after my arrival at Samburg I was surprised to hear the honking of a flock of wild geese. The noise continuing I was impressed by its resemblance to that made by the Canada Goose, and asked my landlord what it meant, as it seemed to proceed from the mainland instead of the lake. He told me it came from a flock of Canada Geese, which had been raised some years previously from a set of eggs taken on the lake.[1] A few days later I came across the birds in a little meadow behind the village and found them to be exactly as represented. Long familiarity with man had completely reversed their natures. So far from showing alarm at my approach they greeted me boisterously, and, led by a large gander, advanced to meet me with outstretched necks and a chorus of defiant notes. This gave me a fine opportunity to determine that they were typical *canadensis*, and at the same time test the strength of a wing-shot from the enraged gander as he danced around for a flank movement while I was making advances upon his family. Strange to

On a signal from mother goose he redoubles his outcries and, describing a large circle immediately beneath the nest, beats the water with his wings, dives, paddles and slashes about with the greatest fury, making such a terrible noise and commotion that he can be heard for several miles. This effectually drives away from that spot every catfish, spoonbill, loggerhead, hellbender, moccasin, water-snake, eagle, mink and otter that might take a fancy to young goslings and into the midst of the commotion, mother goose, by a few deft thrusts of her bill, spills the whole nestful. But a few seconds elapse ere the reunited family are noiselessly paddling for the shores of some secluded cove with nothing to mark the scene of their exploits but a few feathers and upturned water-plants and above them the huge white cypress with its deserted nest.

"Nearly every summer young geese were captured at Open Lake, in Lauderdale County, but they never breed there now, I hear." B. C. Miles.

33. ?**Branta nigricans** (Lawr.) Black Brant.

I have the following from Mr. Miles. "We have the Black-breasted Brant, one of which I killed many years ago." Whether this was *nigricans* or our eastern *bernicla* is uncertain. Judging by the name used by Mr. Miles and the fact that *nigricans* is often taken in the Mississippi Valley, it was very likely the former.

Genus OLOR Wagler.

34. **Olor columbianus** (Ord). Whistling Swan.

35. **Olor buccinator** (Rich.). Trumpeter Swan.

Swans are now rather rare at Reelfoot Lake. A few were seen the present (1895) spring, but which species it is difficult to state. That both species are likely to pass along the Mississippi Valley is sufficient reason for not omitting *columbianus*, which is the rarer of the two in that region.

Mr. Miles writes: "The Swan was formerly quite plentiful here, though I doubt if one has been seen in this or Lauderdale County, on the water, in ten years."

Order HERODIONES.

Family ARDEIDÆ.

Genus BOTAURUS Stephens.

36. **Botaurus lentiginosus** (Montag.). American Bittern.

Two of these birds were killed (presumably in Haywood Co.) by

Mr. B. C. Miles, "in broom sedge on a hill." Mr. Miles writes:—"I am certain he does not breed here."

Genus ARDETTA Gray.

37. **Ardetta exilis** (Gmel.). Least Bittern.

Mounted specimens in Mr. Schmidt's collection.

Genus ARDEA Linnæus.

38. **Ardea herodias** L. Great Blue Heron.

Becoming a rare bird in Tennessee. A few mounted specimens were seen. Living birds were noted at Samburg, Memphis, Raleigh and Harriman. Dr. Merriam notes one July 29, 1887, in the valley of the Little Tennessee. Haywood and Landerdale Counties; Miles.

39. **Ardea candidissima** Gmel. Snowy Heron.

Two or three mounted specimens examined. "Seen in flocks of 12 or 15, apparently on passage and again singly"; Miles.

40. **Ardea virescens** L. Green Heron.

Observed all across the State. Dr. Fox and Mr. Langdon both record it.

Genus NYCTICORAX Stephens.

41. **Nycticorax nycticorax nævius** (Bodd.). Black-crowned Night Heron.

I did not see this species, but heard one at night at Greeneville. Dr. Fox records it from Roane County. Its apparent absence from western Tennessee is unaccountable to me. Mr. Miles never saw one there.

Order PALUDICOLÆ.

Genus PORZANA Vieillot.

4 5. ***Porzana carolina** (L.). Sora Rail.

Abundant around Reelfoot Lake, where, by its noise and actions' it seemed to be breeding.

A specimen was taken and another seen near Bellevue on the 20th of May in a small upland swamp.

Genus GALLINULA Brisson.

46. **Gallinula galeata** (Licht.). Florida Gallinule.

This is without much doubt the "Lead-colored Dumpy Duck" which Mr. Miles includes among the species which breed in his region. He says it is "rarely seen now, but common 20 years since—not fit for table," etc. He does not confound this with the Coot, which he describes (l.c.) as distinct.

Genus FULICA Linnæus.

47. **Fulica americana** Gmel. American Coot.

Abundant on Reelfoot Lake where they breed. Reported also from the interior; Nashville. Several in the city park at Memphis. Roane County; Fox. Under the name "Didopper," Mr. Miles gives a careful and accurate description of this bird, stating it to be common in all waters. He has killed them on flats several hundred yards from water.

Order LIMICOLÆ.

Family SCOLOPACIDÆ.

Genus PHILOHELA Gray.

48. **Philohela minor** (Gmel.). American Woodcock.

Reported from several points, and specimens examined, but not seen in the flesh. Roane County; Fox. More numerous in migrations in Haywood County. "Very scarce of late years, though even now they nest with us."—Miles.

Genus GALLINAGO Leach.

49. **Gallinago delicata** (Ord). Wilson's Snipe.

Noted at Samburg and Memphis. Fox says they are abundant in Roane County during spring migrations. "In large numbers some years and in others not at all," in Haywood County. "A few, I have heard, breed here, never saw a nest."—Miles.

Genus EREUNETES Illiger.

50. **?Ereunetes pusillus** (L.). Semipalmated Sandpiper.

Four or five sandpipers were seen on the shores of a rocky pond on South Harpeth river in the northern corner of Williamson County, They were very tame, being gorged with the small mollusks (*Strepomatidæ*) abounding on the half-exposed rocks, and I feel assured of the correctness of my identification. This is probably the species seen in company with Wilson's plover in Haywood County by Mr. Miles.

Genus TOTANUS Bechstein.

51. Totanus melanoleucus (Gmel.). Greater Yellow Legs.

One was seen in company with the sandpipers above noted. Another was heard at Samburg and stuffed specimens noted at Memphis.

52. Totanus solitarius (Wils.). Solitary Sandpiper.

Observed at Samburg, Memphis, Raleigh, Nashville and Bellevue. Noted in spring in Roane County by Fox and in the Chilhowee Mountains in late August by Langdon.

The late date at which I observed a pair near Bellevue (May 20th.) would indicate that they do not go far out of the State to breed.

Genus BARTRAMIA Lesson.

53. Bartramia longicauda (Bechst.). Bartramian Sandpiper.

I did not observe this species, though I fancied I heard it passing over in West Tennessee. It is doubtful that it breeds at all in the exact localities I explored, but owing to its peculiarly local preferences, will no doubt be found to summer in some of the country *en route*. Dr. Merriam observed five plover flying over Athens,

57. **?Ægialitis semipalmata** Bonap. Semipalmated Plover.

58. **?Ægialitis meloda circumcincta** Ridgw. Belted Piping Plover.

One or both of these species are alluded to by Mr. Miles as Ringneck Plovers, with a call note "Pee, Pee," which remain "a few days in spring and fall," in company with another species without the ring. The latter was probably a Sandpiper, *Ereunetes*.

Order GALLINÆ.

Genus COLINUS Lesson.

59. **Colinus virginianus** (L.). Bob White.

In no part of the United States have I seen our eastern Quail so abundant as it was in West and Middle Tennessee. It was also numerous in the mountains, a pair being seen on Roan Mountain just below the fir belt at a height of nearly 5,000 feet.

Genus BONASA Stephens.

60. **Bonasa umbellus** (L.). Ruffed Grouse.

Seen at Sawyer's Springs, Harriman, Allardt, Johnson City and Roan Mountain. In my experience I would say this bird was rare in all localities. Fox says "rather common in the mountains" of Roan Co. Langdon saw one on Mt. Nebo. Lookout Mountain; Fox

Genus MELEAGRIS Linnæus.

61. **Meleagris gallopavo** L. Wild Turkey.

The Turkey exists in considerable numbers in secluded parts of the Cumberland plateau and the Great Smoky Range. It was reported to me at Sawyer's Springs, Allardt, and Roan Mountain, but I did not see any. Roan Co., Fox. Chilhowee Mts., Langdon.

Mr. Miles informs me that in Haywood County it is a rather scarce bird but in the last few years it seems to be "on the increase." Continuing, he writes: "In 1891 saw a drove numbering at least forty, this in February, and know of at least ten broods now . . . in the county. Last year there were killed about forty that I saw or heard of."

Genus ECTOPISTES Swainson.

62. **Ectopistes migratorius** (L.). Passenger Pigeon

The general verdict of Tennesseeans regarding this bird is in line with that of other parts of the country. They are rarely seen, some dating the last occurrence of the species in Tennessee back nine years.

For the best account of the disappearance of this celebrated bird in Tennessee, I am again indebted to Mr. Miles; he says: "Wild Pigeons last visited our section [Brownsville] in numbers in the year 1881, but were not as numerous as about eight years before — I remember that I remarked then they were depleted. In the fall of 1893, Mr. Riddick of this town killed one of a flock of eight, five miles from here—the last I know of being in the county. The first I remember of them must have been in the year 1851, when I was five years old. They roosted that fall ten miles from here and about a mile from our home. Permission was given me to go with the negroes to the roost, and I well remember one of them put me in a cotton hamper and carried me on his shoulders, and how scared I was at the noise when we arrived—however, we got our bags and baskets full; killed them with poles—and got back early. That was my first taste of sport and I have been a sportsman ever since. As near as I can recall the dates, we had them in 1853–1855 — that year I had a gun and shot them in Carroll County, this State. In 1856 I went to Virginia . . . In 1863 in Virginia they were as plenty as ever. In 1865 I was here [Brownsville] and that fall a few came in scattering flocks and I was ready for them. In 1866 there were more than in '65, in '67 more still, though not in the overwhelming numbers, and we feared their extermination then. Thence till '81, while there were every year more or less to be killed easily, we saw them no more in droves. That year they came for the last time, and as though to take our farewell shot, every one, man to Kingston, about a half mile from the former town, to see a Ground Dove stepping along only fifty feet ahead of me. It flew into a tree by the roadside, and as I approached, flew away entirely out of sight.

The small size and square cut tail, to say nothing of its color, so positively showed it to be this species that I have little hesitation in including it here. Had I not formerly made the acquaintance of this bird in Florida, and become aware of its having been taken in the District of Columbia and at Locke, Michigan, this occurrence would have been passed over as a case of mistaken identity. There is no probability that the Ground Dove is more than a straggler across the eastern confines of the Appalachian system at this latitude. It is more probable this bird came directly north from Georgia or Alabama than from the Carolinas, and its casual occurrence in Southwestern Tennessee would be far less extraordinary than the one just recorded.

Order RAPTORES.

Family CATHARTIDÆ.

Genus CATHARTES Illiger.

65. Cathartes aura (L.). Turkey Vulture.

I saw this useful and conspicuous bird wherever I remained long enough to make any records. It was seen above Roan Mountain. They breed in great numbers along the east escarpment of the Cumberland Plateau.

Genus CATHARISTA Vieillot.

66. Catharista atrata (Bartr.) Black Vulture.

The abundance of this species all over the State was a surprise to me. It was not found, however, east of the Tennessee Valley, but was observed at nearly every other station. It was nearly always in company with the Turkey Vulture in the proportion of one *atrata* to three *aura*, and they were evidently nesting together along the rocky cliffs east of Sawyer's Springs which overlook the wide valley of East Tennessee. Fox records them in flocks in Roane County. Monroe County, "breeds," Lemoyne. "Breeds in the Forked Deer bottom, 10 miles N. E. of" Brownsville, B. C. Miles. Lookout Mountain, "breeds," Fox.

Family FALCONIDÆ.

Genus ELANOIDES Vieillot.

67. Elanoides forficatus (L.). Swallow-tailed Kite.

Wilson's is the first and only Tennessee record for this Kite that I can discover. In the American Ornithology he says (Vol. VI, 1812, p. 70); "I met these birds, in the early part of May at a place called Duck Creek, in Tennessee."

From the known course of his route, this was in Hickman County, about forty miles east of the Tennessee River, in the Duck River bottoms near the east boundary of Maury County. The Swallow-tailed Kite is likely to be found anywhere in west Tennessee in summer, where the bottom lands afford it congenial surroundings and good nesting sites.

Of this species Mr. Miles writes: "I think I killed one fifteen years since, and have seen one since, though very rare."

Genus ELANUS Savigny.

68. Elanus leucurus (Vieill.). White-tailed Kite.

Haywood and Lauderdale Counties; B. C. Miles. See note for next species.

Genus ICTINIA Vieillot.

69. Ictinia mississippiensis (Wils.). Mississippi Kite.

A Kite, whose appearance most closely resembled this species, was seen soaring for a long time over a meadow near Raleigh.

Genus BUTEO Cuvier.

72. Buteo borealis (Gmel.). Red-tailed Hawk.

73. Buteo lineatus (Gmel.). Red-shouldered Hawk.

My records of these are too confused to separate them. Both species however were seen and identified both alive and stuffed.

Western records of *borealis* were made on hearing their notes, but I afterwards found that the jays of that region imitated these with such exactness that I could not rely on the records I had previously made.

Both of these hawks are rare summer residents in the parts visited by me.

74. Buteo latissimus (Wils.). Broad-winged Hawk.

In east Tennessee this is the most abundant hawk, especially so among the mountains, where I found it at the loftiest elevations.

Genus AQUILA Brisson.

75. Aquila chrysaetos (L.). Golden Eagle.

This eagle is occasionally seen at Roan Mountain, in which neighborhood they are resident.

Set of eggs and nesting birds taken on Bald Mountain (Blount County); Lemoyne.

Genus HALIÆETUS Savigny.

76. Haliæetus leucocephalus (L.). Bald Eagle.

Several mounted skins were noted. It is said to breed at Samburg. I think I saw one from the top of Roan Mountain. Saw one in a cage at Union City.

Genus FALCO Linnæus.

77. Falco peregrinus anatum (Bonap.). Duck Hawk.

While watching a flock of vultures circle about me on the cliffs near Sawyer's Springs a Duck Hawk suddenly dashed among them with a shrill scream and in a few moments had scattered them far away over the valley. It then returned to its eyrie near the cascade of Falling Water. Breeding in the Great Smoky Mountains, Lemoyne.

78. Falco sparverius L. Sparrow Hawk.

Noted at Samburg, Raleigh, Bellevue and Chattanooga, and at intermediate points along the railroad lines. Not as common as in the Middle States. Not seen in the mountains, but noted there by Fox and Langdon and Lemoyne, the latter stating it is rare.

Genus PANDION.

79. Pandion haliaetus carolinensis (Gmel.). American Osprey.

Seen in Roan County in April by Fox. I did not see it at Samburg but the fishermen there spoke of it. Great Smoky Range, Lemoyne.

Family STRIGIDÆ.

Genus STRIX Linnæus.

80. Strix pratincola Bonap. Barn Owl.

A pair of these in captivity were examined at Union City.

Genus SYRNIUM Savigny.

81. Syrnium nebulosum (Forst.). Barred Owl.

The unmistakable call of this owl was heard at Samburg, Raleigh and Bellevue. Breeding at base of Bald Mountain (Blount County); common at all altitudes in the Smokies; Lemoyne.

Genus MEGASCOPS Kaup.

82. Megascops asio (L.). Screech Owl.

Mounted specimens were the only ocular proof I had of the presence of this bird in Tennessee. I did not even hear one during the entire trip, but was assured of their being common enough for the every day needs of the more superstitious natives. Chilhowee Mountains; Langdon. Roane County; Fox. Not common in the Great Smoky Mountains; Lemoyne.

Genus BUBO Duméril.

descending an immense declivity and coursing along the rich valley of Mansker's Creek, where I again met with large flocks of paroquets, I stopped at a small tavern," etc. This was during his trip from Lexington to Natchez. Again in his journal, dated April 25th of the same year, is the following entry:—" Breakfasted at Walton's, thirteen miles from Nashville. This place is a fine, rich hollow, watered by a charming, clear creek, that never fails. Went up to Madison's Lick, where I shot three paroquets and some small birds."

Mansker's Creek was north of Nashville, probably in Robertson County. Madison's Lick is in the Cumberland Valley, Davidson County. These records were not published until 1828, when George Ord issued a more complete edition of his "Sketch" of Wilson, containing many letters not in the first edition and among them the one to Lawson containing the above notes.

In his Ornithology (1811) Wilson (Vol. III, p. 91) gives Madison's Lick as the first place in Tennessee in which he saw Parrots, and continues: "In passing on I next met with them on the banks and rich flats of the Tennessee River;" . . . . . The latter region, however, is the debatable one of the old "Natchez Trace" road which here crossed the Tennessee line in the southwest corner of Wayne County and the northwestern corner of Lauderdale County, Alabama and thence south into Tishomingo County, Mississippi, It is not unlikely that he saw paroquets in all of these counties; certainly at least, in Alabama, a fact overlooked by Hasbrouck in his paper in the Auk on this bird.

From what is known of the breeding habits, of the Carolina Paroquet in other localities there is no doubt that it was a summer resident in the river bottoms of west Tennessee in Wilson's day.

Mr. Miles communicates the following valuable note on the Paroquet in a recent letter:—" In the early 50's a flock of Paroquets came to our orchard [near Brownsville] and we chased them out and killed them with sticks and apples; saw a flock at Ashport [Lauderdale County] on the Mississippi River 100 in number in 1874, and saw one killed alone, within five miles of this [Brownsville] in 1876 —the last I have ever heard of."

Order COCCYGES.

Family CUCULIDÆ.

Genus COCCYZUS Vieillot.

85. **Coccyzus americanus** (L.). Yellow-billed Cuckoo.

86. **Coccyzus erythrophthalmus** (Wils.). Black-billed Cuckoo.

Cuckoos were noted at all points visited, except the top of Roan Mountain. From the character of their notes, (by which alone the Black-billed species was identified) I judge there were five times as many of the former as of the latter. It is probable, however, that the Black-billed Cuckoo is much less noisy and hence less often observed. Dr. Merriam records, "*Coccyzus.* Heard several times;" at Athens. Fox and Langdon make no mention of either species.

Family ALCEDINIDÆ.

Genus CERYLE Boie.

87. **Ceryle alcyon** (L.). Belted Kingfisher.

A common summer resident at all collecting stations except on the tops of the higher mountains. Not seen at Allardt or Sawyer's Springs, but going up the escarpment, they were noted nearly to the plateau. Langdon found them in the coves of Little River. I did not see any above 4,000 feet on Roan Mountain.

Order PICI.

Family PICIDÆ.

Genus DRYOBATES Boie.

88. **Dryobates villosus** (L.). Hairy Woodpecker.

91. ***Dryobates borealis** (Vieill.). Red-cockaded Woodpecker.

This bird was found breeding on the Cumberland plateau at Allardt and on the route from Allardt to Rugby Road in Morgan and Scott Counties. I did not see it elsewhere. Two specimens were secured. At Allardt the nests were excavated at a height of thirty or forty feet in living pine trees. The young were nearly fledged at that date, June 8th. Fox calls it a rare bird at Rockwood, in spring, where he took a specimen April 22nd.

Genus SPHYRAPICUS Baird.

92. **Sphyrapicus varius** (L.). Yellow-bellied Sapsucker.

A pair were seen along Doe River, Roan Mountain, at an elevation of about 4,000 feet. They acted as if they had a nest near by.

Fox records them as "not very common" in spring in Roan County. These were probably migrants. It is doubtful if any breed in the Cumberland Mountains of Tennessee. Langdon did not find them.

Genus CEOPHLŒUS Cabanis.

93. **Ceophlœus pileatus** (L.). Pileated Woodpecker.

Seen or heard at Samburg, Raleigh, Bellevue, Harriman, Allardt and Greeneville. Reported by both Fox and Langdon. It is found on Roan Mountain. Little Tennessee Valley; Merriam.

Genus MELANERPES Swainson.

94. **Melanerpes erythrocephalus** (L.). Red-headed Woodpecker.

Very abundant in west and middle Tennessee, but rare at higher altitudes in the east. I recorded it at Samburg, Raleigh, Bellevue, Chattanooga, Harriman and Allardt. Fox records one spring example; Langdon says it is "common about clearings in the foothills" of the Chilhowee Mountains, but not found above 1,500 feet. Abundant at Athens, Merriam.

95. ***Melanerpes carolinus** (L.). Red-bellied Woodpecker.

Very abundant at Samburg and Raleigh. Several seen at Bellevue, Chattanooga, Sawyer's Springs and Harriman. Fox says it was "rather common" in April, 1885, at Rockwood.

Genus COLAPTES Swainson.

96. **Colaptes auratus** (L.). Flicker.

Nowhere did I find this bird as abundant as in the Middle States, but it was seen in all localities, from river bottom to mountain peak, being one of the few lowland birds which makes its home at Cloudland.

I am unable to include among the Woodpeckers of Tennessee the Ivory-billed, *Campephilus principalis*, owing to absence of any records. Mr. Hasbrouck (l.c.) refers to it thus: "For Tennessee no records have been found, although it would seem highly probable that the bird occurs in the bottom lands bordering the Mississippi especially when we consider the records from Fulton County, Kentucky . . . and also those directly south in Louisiana and west in Arkansas."

Order MACROCHIRES.

Family CAPRIMULGIDÆ.

Genus ANTROSTOMUS Gould.

97. **Antrostomus carolinensis** (Gmel.). Chuck-will's widow.

Heard several every night of my stay at Raleigh. The Whippoorwill was not heard there. Fox doubtfully refers a Goatsucker seen near Rockwood to this species. Wilson first encountered this bird on the banks of the Cumberland near Nashville, in his journey from Lexington to Natchez.

97. **Antrostomus vociferus** (Wils.). Whippoorwill.

I have records of this species from Samburg, Bellevue, Chattanooga and Allardt. At the last mentioned place it was very numerous. Other observers do not mention it.

Family TROCHILIDÆ.

Genus TROCHILUS Linnæus.

100. Trochilus colubris (L.). Ruby-throated Humming-bird.

Not seen on top of Roan Mountain, but up to a high altitude, say 4,500 to 5,000 feet. Elsewhere in Tennessee it is a cosmopolite. Langdon limits it to 3,000 feet in the Chilhowee regions.

Order PASSERES.

Family TYRANNIDÆ.

Genus TYRANNUS Cuvier.

101. Tyrannus tyrannus (L.). King Bird.

The only locality where this abundant summer resident was not seen was among the higher reaches of Roan Mountain. Not seen, but probably found, at Roan Mountain Station. Langdon did not find it above the "coves."

Genus MYIARCHUS Cabanis.

102. Myiarchus crinitus (L.). Crested Fly-catcher.

My notes say "everywhere" for this flycatcher. The only possible exception to this is the summit of Roan Mountain. It comes up some distance into the fir belt, nevertheless. Strange to say, Langdon does not mention it, nor is it recorded by Dr. Merriam. It is abundant in west and middle districts.

Genus SAYORNIS Bonaparte.

103. Sayornis phœbe (Lath.). Phœbe.

Not observed west of the valley of east Tennessee. Recorded first at Chattanooga, also at Sawyer's Springs, Harriman, Allardt, Johnson City and Roan Mountain Station. At Rockwood; "common," Fox. Athens, "not common;" Merriam. Not given by Langdon. I saw very few anywhere.

Genus CONTOPUS Cabanis.

104. Contopus borealis (Swains.). Olive-sided Flycatcher.

Passing down Rock Creek valley on the northwest side of Roan Mountain I heard the weird, striking cry of this species and my search was soon rewarded by seeing the bird catching insects from the top of a lofty dead hemlock along the roadside. The place was a narrow cove and the altitude about 4,000 feet. About two miles from this spot on the cross road to the Doe River valley I found another in a similar environment. This flycatcher was found in the mountains of western North Carolina by Mr. Brewster but is not given in previous Tennessee records. It is a rare summer resident in this region.

105. **Contopus virens** (L.). Wood Pewee.

This flycatcher was found all over the state, including the mountains, up to the fir belt.

Genus **EMPIDONAX** Cabanis.

106. **Empidonax acadicus** (Gmel.). Acadian Flycatcher.

The absence of all members of this genus from the lists of Fox and Langdon is a surprise to me, as I found the Acadian everywhere below 3,500 over the entire state. It was abundant in west and middle Tennessee. Dr. Merriam lists it as common near Athens; also giving it in his list of Little Tennessee birds.

107. ***Empidonax pusillus traillii** (Aud.). Traill's Flycatcher.

A male, in full song, was shot near Bellevue. It was undoubtedly a migrant.

108. **Empidonax minimus** (Baird). Least Flycatcher.

As a migrant, I saw this species at Samburg and Raleigh. It breeds at Roan Mountain Station and thence up the Doe River Valley to near the limit of deciduous trees, say 4,500 feet.

Family CORVIDÆ.

111. **Corvus americanus** (Aud.). American Crow.

The Crow was not abundant but everywhere represented, except in the evergreen mountain belt. Langdon did not find it above 3,000 feet, but it attains a much greater elevation.

Family ICTERIDÆ.

Genus DOLICHONYX Swainson.

112. **Dolichonyx oryzivorus** (L.). Bobolink.

Abundant as a migrant at Samburg and Raleigh. Also seen at Bellevue and Chattanooga but I have no evidence that they breed in those localities other than the late date of their presence there.

Genus MOLOTHRUS Swainson.

113. **Molothrus ater** (Bodd.). Cow-bird.

Noted at Samburg and, questionably at Raleigh. I should say this species was rare in summer in Tennessee. Fox says it is not common in Roane County.

Genus AGELAIUS Vieillot.

114. **Agelaius phœniceus** (L.). Red-winged Blackbird.

Breeding all over the state, but less abundant than in the Middle States. I did not observe it on Roan Mountain, nor does Langdon record it.

Genus STURNELLA Vieillot.

115. **Sturnella magna** (L.). Meadowlark.

Distribution same as with the preceding species, but more uniformly abundant. It was noted around Roan Mountain Station.

Genus ICTERUS Brisson.

116. **Icterus spurius** (L.). Orchard Oriole.

117. **Icterus galbula** (L.). Baltimore Oriole.

Both species abundant and with the same distribution all over the state, except above 3,500 to 4,000 feet in the Smoky Mountains.

Of the two, the Baltimore was the most abundant, more numerous, indeed, than I ever saw it elsewhere in the United States.

Genus SCOLECOPHAGUS Swainson.

118. **Scolecophagus carolinus** (Müll.). Rusty Blackbird.

Migrating in flocks with Cow-birds and Redwings at Samburg. Rockwood, Fox.

Genus QUISCALUS Vieillot.

119. Quiscalus quiscula (L.). Purple Grackle.

Admitted on evidence of nine specimens procured by Dr. Fox in Roane County and identified by Mr. Ridgway, who states (footnote) that this appears to be the prevailing form in east Tennessee.

I observed Grackles at Chattanooga, Harriman, Knoxville, Greeneville and Johnson City, but none were secured. Found at Athens, Merriam.

120. *Quiscalus quiscula æneus (Baird). Bronzed Grackle.

Four breeding birds shot at Samburg are typical *æneus*. In the absence of contrary evidence, the Grackles noted at Raleigh and Bellevue are likewise referable to this form.

Reelfoot Lake, with its ruined, half-submerged forest of decaying trees affords ideal building sites for a large colony of these birds. In that locality they appear to invariably select a cavity (either natural, or one made by woodpeckers) in dead trees standing in deep water, in which to rear their young. Some of these are at a great elevation, others were found in stubs only ten feet high. Two specimens of this race were taken by Dr. Fox near Rockwood.

Family FRINGILLIDÆ.

Genus CARPODACUS Kaup.

121. Carpodacus purpureus (Gmel.). Purple Finch.

The only record known to me is that of Dr. Fox who secured specimens in March in Roane County. I had expected to find it on

Genus PASSER Brisson.

125. Passer domesticus (L.). European House Sparrow.

Abounding in all larger towns and villages and their suburbs.

Genus POOCÆTES Baird.

126. Poocætes gramineus (Gmel.). Vesper Sparrow.

Not seen west of Johnson City, where I found it breeding, but not abundantly. Fox notes it in April in Roane County but I did not find it breeding there.

Genus AMMODRAMUS Swainson.

127. Ammodramus sandwichensis savanna (Wils.). Savanna Sparrow.

Fox's record of this species in Roane County during March is the only one known to me.

128. Ammodramus savannarum passerinus (Wils.). Grasshopper Sparrow.

Found at Samburg, Raleigh, Bellevue, Chattanooga, Knoxville, Greeneville and Johnson City; certainly resident at the five latter places in summer. Not found by Langdon or myself in the Great Smoky Range.

129. Ammodramus henslowii (Aud.). Henslow's Sparrow.

Two specimens (March and April), taken in Roane County by Fox.

Genus CHONDESTES Swainson.

130. *Chondestes grammacus (Say.). Lark Sparrow.

A flock, probably migrant, was seen in a field near Samburg. One of these was secured. A singing male gave me an unsuccessful chase over the fields near Raleigh, and a pair, evidently mated, were found near Bellevue, the male becoming a sacrifice to science.

It appears to be rather rare in any part of the state. Other observers do not list it.

Genus ZONOTRICHIA Swainson.

131. Zonotrichia leucophrys (Forst.). White-crowned Sparrow.

Numerous at Samburg, Raleigh and Bellevue. At the latter place it was seen as late as May 22nd.

132. Zonotrichia albicollis (Gmel.). White-throated Sparrow.

Several seen at Samburg and Bellevue. Roane County, March and April; Fox. Not known to breed.

Genus SPIZELLA Bonaparte.

133. Spizella socialis (Wils.). Chipping Sparrow.

With the exception of the summit of Roan Mountain, this bird was always present in my rambles through Tennessee. Langdon found it up to 4,000 feet in the mountains.

134. Spizella pusilla (Wils.). Field Sparrow.

The remarks for *socialis* equally apply to this species.

Genus JUNCO Wagler.

135. Junco hyemalis (L.). Slate-colored Junco.

The birds referred to by Fox, the last of which were seen April 16th, around Rockwood, have been identified with this migrant northern form.

136. *Junco hyemalis carolinensis (Brewst.). Carolina Junco.

Abundant on Roan Mountain in the fir belt. One heard singing in the upper deciduous belt at about 4,500 feet. Eleven specimens, including four half-fledged young, were taken.

Genus PEUCÆA Audubon.

137. *Peucæa æstivalis bachmani (Aud.). Bachman's Sparrow.

Breeding numerously on the plateau in the parts of Fentress, Scott and Morgan Counties traversed on the trip from Sunbright to Allardt and returning to Rugby Road. Also noted near Sawyer's Springs. Three specimens were taken at Allardt. Fox found it in April in Roane County and on Lookout Mountain.

along the foothills of the Great Smoky Range. It is included here on the authority of Dr. Fox, who found it abundant in Roane County during April. That it breeds there is doubtful.

140. ***Melospiza lincolni** (Aud.). Lincoln's Finch.

This bird was migrating during my stay in West Tennessee. Several were seen near Samburg and Raleigh. It was also observed at Bellevue. A male shot at Raleigh was very fat.

Genus PASSERELLA Swainson.

141. **Passerella iliaca** (Merr.). Fox Sparrow.

Not seen. Taken in spring migration in Roane County.; Fox.

Genus PIPILO Vieillot.

142. **Pipilo erythrophthalmus** (L.). Towhee.

Not seen in West Tennessee; not common in the middle districts. Records at Bellevue, Chattanooga, Harriman, Allardt, Knoxville, Johnson City and Roan Mountain Station. Rare at latter station, which is its highest limit in the mountains. Taken at Athens; common; Merriam; and at 2,000 feet in Chilhowee Mountains, Langdon.

Genus CARDINALIS Bonaparte.

143. **Cardinalis cardinalis** (L.). Cardinal.

Very abundant everywhere, up to nearly 4,000 feet in the mountains.

Genus HABIA Reichenbach.

144. **Habia ludoviciana** (L.). Rose-breasted Grosbeak.

Migrating at Samburg, Raleigh and Bellevue. Seen at Chattanooga and Sawyer's Springs. Breeds at Johnson City and thence up to the fir belt of Roan Mountain, 4,800 feet.

It may be a rare breeder in the Cumberland Mountains, but I have no proof of it.

145. **Passerina cyanea** (L.). Indigo Bunting.

Very abundant over my entire route, and one of the few lowland birds that breed at the summit of Roan Mountain.

146. ***Spiza americana** (Gmel.). Dickcissel.

Abundant in all cultivated uplands, from the Mississippi River to the western escarpment of the Cumberland Plateau. Sparsely straggling along the Tennessee Valley to Chattanooga, where one was heard singing. Not seen at Knoxville. Four specimens taken.

Family TANAGRIDÆ.

Genus PIRANGA Vieillot.

147. **Piranga erythromelas** (Vieill.). Scarlet Tanager.

Over the entire State, and in the mountains up to 4,000 feet. More abundant in East Tennessee.

148. ***Piranga rubra** (L.). Summer Tanager.

Noted at all visited localites, up to 2,500 feet. More abundant in west and middle districts.

Family HIRUNDINIDÆ.

Genus PROGNE Boie.

149. **Progne subis** (L.). Purple Martin.

Numerous everywhere except on the mountains. Not seen at Sawyer's Springs, but at Allardt I saw some. Not seen at Roan Mountain Station.

Genus PETROCHELIDON Cabanis.

150. **Petrochelidon lunifrons** (Say). Cliff Swallow.

Noted at Raleigh, Bellevue, Harriman and Johnson City. Not elsewhere recorded nor by other observers.

Genus CHELIDON Forster.

151. **Chelidon erythrogaster** (Bodd.). Barn Swallow.

Not abundant. Seen at Raleigh, Bellevue, Chattanooga, Knoxville, Greeneville and Johnson City. Athens; Merriam. Rock-

Family AMPELIDÆ.

Genus AMPELIS Linnæus.

155. Apelis cedrorum (Vieill.). Cedar Waxwing.

Quite universal in its State distribution. I did not find it on the summit, but far up Roan Mountain. Langdon took a young one as high as 3,000 feet.

Family LANIDÆ.

Genus LANIUS Linnæus.

156. Lanius ludovicianus (L.). Loggerhead Shrike.

Observed at Samburg and Raleigh, and breeding between the latter place and Memphis. Roane County, March 18th and 20th; Fox.

Family VIREONIDÆ.

Genus VIREO Vieillot.

157. Vireo olivaceus (L.). Red-eyed Vireo.

Abounding in all localities visited, up to the fir-belt of Roan Mountain.

158. Vireo gilvus (Vieill.). Warbling Vireo.

Several noted at all stops between Samburg and Johnson City, inclusive. No other observer records them from Tennessee.

159. Vireo flavifrons (Vieill.). Yellow-throated Vireo.

Same distribution as last. Pine Mountain at 1,500 feet; Langdon. Abundant.

160. Vireo solitarius (Wils.). Blue-headed Vireo.

Taken by Fox in Roane County (April 15th and 17th), during migration.

161. Vireo solitarius alticola (Brewst.). Mountain Solitary Vireo.

A few heard on Roan Mountain, from just below fir belt down to 3,000 feet. Owing to their preference for the highest tree tops I was unable to shoot any specimens with my cane-gun.

Specimens taken by Langdon on Pine and Defeat Mountains were pronounced to be typical of this race by Mr. Brewster. Lemoyne took specimens in Blount and Monroe Counties, which he thinks referable to both forms. As he gives no date for the one from Monroe County, which he calls *solitarius*, one may infer that it was only a migrant.

162. Vireo noveboracensis (Gmel.). White-eyed Vireo.

Seen at all points between Roan Mountain Station and Samburg, inclusive. An abundant species everywhere. Chilhowee Mountains; Langdon.

Family MNIOTILTIDÆ.

Genus MNIOTILTA Vieillot.

163. **Mniotilta varia** (L.). Black and White Warbler.

An abundant summer resident, with the same distribution as the White-eyed Vireo, but ranging higher on Roan Mountain, viz., up to 3,500 feet. Chilhowee Mountains, 3,000 feet, Langdon.

Genus PROTONOTARIA Baird.

164. ***Protonotaria citrea** (Bodd.). Prothonotary Warbler.

Abounding in the Mississippi Bottoms and along the nearer tributaries. Probably found nearly across west Tennessee. Breeding at Samburg, Memphis and Raleigh. Five specimens preserved and a set of eggs.

Genus HELINAIA Audubon.

165. ***Helinaia swainsonii** (Aud.). Swainson's Warbler.

Several heard and a few seen in the cane bottoms of Wolf River near Raleigh, where it was breeding. Two males, after the most persistent and tiresome stalking, were brought down. From the nature of the swamps and bayous of the Tennessee River it may be safely predicted that this bird will be found in nearly every county between its western valley and the Mississippi.

Genus HELMITHERUS Rafinesque.

169. **Helminthophila ruficapilla** (Wils.). Nashville Warbler.

Alexander Wilson secured the types of this species near Nashville. It was migrating at Samburg and Raleigh during my stay.

170. **Helminthophila peregrina** (Wils.). Tennessee Warbler.

Migrating through Samburg, Raleigh and Bellevue. Wilson's types of this bird came from the banks of the Cumberland River, probably not far from Nashville.

Genus COMPSOTHLYPIS Cabanis.

171. **Compsothlypis americana** (L.). Parula Warbler.

Breeding abundantly at every locality except above 4,000 feet in the mountains.

Genus DENDROICA Gray.

172. **Dendroica æstiva** (Gmel.). Yellow Warbler.

Not seen in west Tennessee; a few seen at Nashville. Numerous in east Tennessee up the mountains, to about 3,500 feet. On the plateau at Allardt.

173. **Dendroica cærulescens** (Gmel.). Black-throated Blue Warbler.

Common from 3,500 to 4,500 feet on Roan Mountain. Head of Little River, 4,000 feet, Langdon. Roane County, 4,300 feet (?); May 16th, Lemoyne.

174. **Dendroica coronata** (L.). Myrtle Warbler.

Fox says this bird was common near the Tennessee River until the last of April.

175. ***Dendroica maculosa** (Gmel.). Magnolia Warbler.

Seen migrating at Samburg and Raleigh, where one specimen was shot.

176. **Dendroica cærulea** (Wils.). Cerulean Warbler.

Breeding at Samburg, Raleigh and Bellevue. Not certainly identified elsewhere. Three specimens taken at Raleigh. Langdon found them "common" in spruce forests at the head of Little River, 4,000 feet.

177. **Dendroica pensylvanica** (L.). Chestnut-sided Warbler.

Breeding on Roan Mountain, 3,500 to 4,000 feet. From 2,000 to 2,500 feet "in oak woods;" Langdon.

178. **Dendroica striata** (Forst). Black-poll Warbler.

An abundant migrant at Samburg and Raleigh and a few seen at Bellevue.

179. Dendroica blackburniæ (Gmel.). Blackburnian Warbler.

Migrant at Samburg, Raleigh and Bellevue. Breeding on Roan Mountain. Rockwood in April, Fox. Langdon found it the "most abundant species of its family" between 2,000 to 4,000 feet in the Chilhowee Mountains. One specimen at Raleigh. Walden's Ridge, Roane County, 4,000 feet; breeding, Lemoyne.

180. *Dendroica dominica albilora (Baird.) Sycamore Warbler.

Records for Bellevue, Harriman, Allardt, Knoxville, Greeneville and Johnson City. Two specimens taken. Breeding at all points noted. Roane County; Fox. Athens; Merriam.

181. Dendroica virens (Gmel.). Black-throated Green Warbler.

Found all across the State; but only as a migrant west of the Cumberland Plateau. Breeding at Sawyer's Springs, Harriman, Allardt, Knoxville, Johnson City, and thence up Roan Mountain to 3,000 feet or more. Spruce woods, 4,000 feet; Langdon. Lookout Mountain, Fox.

182. Dendroica vigorsii (Aud.). Pine Warbler.

Listed at Raleigh, Bellevue and Allardt. Fox found them in full song March 28th, when they were "common" at Rockwood. Pine Mountain, 1,500 feet, "one specimen only," Langdon. I did not notice them on Roan Mountain. Not abundant anywhere.

183. Dendroica discolor (Vieill.). Prairie Warbler.

Numerous in scrub openings at all points visited between Bellevue and Knoxville, inclusive. Two specimens taken. Rockwood,

Genus GEOTHLYPIS Cabanis.

186. *Geothlypis formosa (Wils.). Kentucky Warbler.

Abounding all across the State, from the Mississippi bluff to the foothills of the Great Smoky Mountains. Not seen east of Johnson City but numerous all over the Cumberland Plateau. Langdon did not see it, nor did Fox in 1885, though he records it "not common" in 1884. Nesting in Blount County; June, 1881, and seen in Monroe County; Lemoyne.

187. Geothlypis philadelphia (Wils.). Mourning Warbler.

Migrating at Samburg, Raleigh and Bellevue. Heard one singing at latter place.

188. Geothlypis trichas (L.). Maryland Yellow Throat.

Below an altitude of 3,000 feet this familiar warbler abounds throughout the State. Ridgway shows that the Mississippi Valley birds are intermediate. Those from the Memphis bottoms may be found to be closer to *occidentalis* than to our eastern bird.

Genus ICTERIA Vieillot.

189. Icteria virens (L.). Yellow-breasted Chat.

An abundant summer resident at all points along route as far east as Johnson City. Langdon took one at the "base of Mount Nebo."

Genus SYLVANIA Nuttall.

190. *Sylvania mitrata (Gmel.). Hooded Warbler.

This is the most thoroughly representative and evenly distributed summer warbler of Tennessee; as much at home among the cane brakes and bayous of the Mississippi as in the dark, cool ravines of the Great Smoky Mountains. It ranges up to the fir belt on Roan Mountain; "4,000 feet," Langdon. Great Smoky Mountain and Monroe County, 2,500 to 4,5000 feet; Lemoyne.

191. *Sylvania pusilla (Wils.). Wilson's Warbler.

Migrating at Raleigh and Bellevue. One specimen collected at latter place.

192. Sylvania canadensis (L.). Canadian Warbler.

Migrant at Samburg and Raleigh. Breeding on Roan Mountain, 3,000 to 4,000 feet. Blount County, 2,000 feet; Langdon. Monroe County, 2,500 to 4,000 feet; Lemoyne.

Genus SETOPHAGA Swainson.

193. Setophaga ruticilla (L.). American Redstart.

In favorable localities throughout the entire route from Samburg to Johnson City and Roan Mountain Station. That its breeds at Samburg and Raleigh is not yet proven. Langdon found it up to 2,500 feet.

Family MOTACILLIDÆ.

194. Anthus pennsilvanicus (Lath.). American Pipit.

Recorded in spring (March) by Fox, who found it common in meadows during the last two weeks of that month. I thought I heard a flock passing over Samburg.

Family TROGLODYTIDÆ.

Genus MIMUS Boie.

195. Mimus polyglottos (L.). Mocking Bird.

Rather rare at Samburg, Raleigh, and Bellevue. Reported from Chattanooga. A farmer from Harriman stated they were occasionally heard there. Fox saw one near Rockwood April 6, 1885. I could get no information of them on the Cumberland table land. It is a favorite and common cagebird all over Tennessee and this perhaps, accounts for its rarity in a wild state at the present day.

Genus GALEOSCOPTES Cabanis.

196. Galeoscoptes carolinensis (L.). Catbird.

199. Thryothorus bewickii (Aud.). Bewick's Wren.

Rather local, but found in every county visited. A far more entertaining singer and every way more of a genius than the House Wren, which it replaces in Tennessee.

I heard the song of this bird in a "deadening" 4,000 feet up the side of Roan Mountain.

Genus TROGLODYTES Vieillot.

200. Troglodytes hiemalis (Vieill.). Winter Wren.

A few heard in the fir belt of Roan Mountain; but none below it. It is rare even there. Langdon missed it altogether. Fox notes it in the Tennessee valley as late as April 13th. It is quite possible that the Roan Mountain birds will be found to represent a distinct race, more nearly approaching *pacificus* than *hiemalis.* No specimens have yet been taken in these regions.

Family CERTHIIDÆ.

Genus CERTHIA Linnæus.

201. Certhia familiaris americana (Bonap.). Brown Creeper.

A few were breeding on the summit of Roan Mountain. Seen in migration by Fox, in Roane County. Smoky Mountains in summer, in the valleys in winter; Lemoyne.

Family PARIDÆ.

Genus SITTA Linnæus.

202. Sitta carolinensis (Lath.). White-breasted Nuthatch.

Sparingly distributed over the State. None seen on Roan Mountain above the deciduous timber.

203. Sitta canadensis (L.). Red-breasted Nuthatch.

One specimen was taken in the fir belt of Roan Mountain, to which the birds seemed to be confined, one being heard near the hotel at Cloudland. Lookout Mountain, March 29th, Fox.

Genus PARUS Linnæus.

204. Parus bicolor (L.). Tufted Titmouse.

Everywhere abundant. Ranging as high as 4,000 feet on Roan Mountain.

205. Parus atricapillus (L.) Chickadee.

No Chickadees were seen in the balsam belt of Roan Mountain. Langdon found no specimens of this form among the mountain titmice of Blount County. Lemoyne records specimens from Blount County and Great Smoky Mountain and agrees with Brewster as to the difference in song, etc., between specimens above and below 4,000 feet on these mountains.

206. **Parus atricapillus carolinensis** (Aud.). Carolina Chickadee.

Specimens from Sawyer's Springs and Raleigh are referable to the southern form. I found Chickadees abundant all over the Tennessee lowlands and up Roan Mountain to the evergreen belt. I fail to appreciate the specific distinctions accorded to the southern as contrasted with the northern Chickadee, living as I do in a region where apparent intermediates of the two are found throughout the year. Lemoyne records *carolinensis* from the valleys up to 4,000 feet in the Smoky Mountains of Monroe, Blount and Sevier Counties.

Genus REGULUS Cuvier.

207. **Regulus satrapa** (Licht.). Golden-crowned Kinglet.

The only record known to me is that of Fox, who found them in early spring in Roane County. It is rather surprising that neither Langdon nor myself observed them in the Smoky Mountains, for Brewster found them abundant in the Black Mountains of North Carolina.

208. **Regulus calendula** (L.). Ruby-crowned Kinglet.

Fox lists this bird as a migrant in Roane County. It was migrating through Samburg during my stay.

abundant from 3,000 to 5,000 feet. I watched a pair building in a maple on a large horizontal branch nearly forty feet from the ground; an unusual position for the nest of this bird.

212. Turdus ustulatus swainsonii (Cab.). Olive-backed Thrush.

Migrant at Samburg, Raleigh and Bellevue. Fox saw one April 26th, 1885, in Roane County.

213. Turdus aonalaschkæ pallasii (Cab.). Hermit Thrush.

Seen at Samburg. Fox found it an abundant migrant in Roane County.

Genus MERULA Leach.

214. Merula migratoria (L.). American Robin.

A rare bird in west and middle Tennessee. None seen in the Central Basin. Not abundant in east Tennessee, where it is found from the western rim of the Cumberland Mountains to the top of the Great Smoky range. It was breeding and singing in the balsams near Cloudland Hotel. Langdon did not find it in the Chilhowee Range.

Genus SIALIA Swainson.

215. Sialia sialis (L.). Bluebird.

In many parts of west and middle Tennessee the Bluebird was frequently seen. I have records of it from every place visited up to 4,000 feet on Roan Mountain. Fox found them very common in early spring. Langdon notes a few "about deadenings in the coves" of Blount County.

LIST OF BIRDS COLLECTED IN NORTH GREENLAND BY THE PEARY EXPEDITION OF 1891–2 AND THE RELIEF EXPEDITION OF 1892.

BY WITMER STONE.

In the Proceedings of the Academy of Natural Sciences of Philadelphia for 1892, p. 145, I published an annotated list of the birds collected by the West Greenland Expedition which accompanied Lieut. R. E. Peary to Whale Sound in 1891.

Below will be found lists of the species obtained by the Peary party during their sojourn in North Greenland from July, 1891, to August, 1892, and also of those collected by the Relief Expedition of 1892.

The former collection was made almost entirely by Mr. Langdon Gibson in the vicinity of the Peary winter quarters[1] and the latter by Mr. Charles E. Hite at about the same points visited by the Expedition of 1891. All the specimens, numbering 122, are in the collection of the Academy of Natural Sciences of Philadelphia.[2]

The second Peary Expedition and the Relief Expedition of 1894, so far as I am aware, made no collection of birds.

5. Stercorarius longicaudus Vieill. **Long-tailed Jaeger.**

Obtained in Tuctoo Valley.

6. Gavia alba (Gunn.). Ivory Gull.

One obtained on McCormick Bay, July 17, 1892.

7. Rissa tridactyla (Linn.). Kittiwake.

One specimen in the collection.

8. Larus glaucus Brünn. Glaucous Gull.

One taken at McCormick Bay, July 17, 1892.

9. Clangula hyemalis (Linn.). Old-squaw.

Males and females in perfect breeding plumage obtained in Tuctoo and Glacier Valleys, June 16–21, 1892.

10. Somateria mollissima borealis Brehm. Greenland Eider.

One set of eggs collected June 30, on Whale Sound and several birds secured.

11. Somateria spectabilis (Linn.). King Eider.

Found breeding in Tuctoo Valley, June 9, 1892, and birds were obtained in the same locality as late as July 24.

12. Chen hyperboreus nivalis (Forst.) Greater Snow Goose.

One adult female in worn plumage and one young gosling entirely in down were secured on July 10, 1892, in Glacier Valley. So far as I am aware this capture furnishes the first information that we have regarding the breeding ground of this bird.

13. Tringa canutus Linn. Knot.

A series of specimens of the Knot were obtained in Tuctoo Valley, June 22 to July 22, 1892, and Aug. 23, 1891. Most of these are in breeding plumage and have lost entirely the gray borders to the feathers of the back.

One young bird was obtained which is still in the down but has the wings about half grown and the regular feathers appearing on the breast and back.

14. Calidris arenaria (Linn.). Sanderling.

One specimen was secured in Glacier Valley, June 14, in full breeding dress.

15. Arenaria interpres (Linn.). Turnstone.

Two specimens were taken July 21 and 26, 1892, in Tuctoo Valley.

16. Lagopus rupestris reinhardti (Brehm). Reinhardt's Ptarmigan.

One specimen taken in Inglefield Gulf, April 21, 1892, was still in the pure white plumage.

17. FALCO ISLANDUS Brüun. White Gyr falcon.

One obtained on McCormick Bay.

18. CORVUS CORAX PRINCIPALIS Ridgw. Northern Raven.

One specimen without data.

19. PLECTROPHENAX NIVALIS (Linn.). Snow Bunting.

Several nests taken in Tuctoo Valley, June 19 and 21, each containing five eggs, and one, June 21, containing seven.

COLLECTION OF THE RELIEF EXPEDITION.

1. FRATERCULA ARCTICA (Linn.). Puffin.

Two puffins were secured at Godhavn, which I refer to this form. The bills measure:

No.	Length of culmen.	Depth at base.
30,076	1.85 in.	1.45 in.
30,077	2.05 in.	1.60 in.

2. CEPPHUS MANDTII (Licht.). Mandt's Guillemot.

All the specimens obtained at Nattik and in McCormick Bay were of this species. None of *C. grylle* being found.

3. URIA LOMVIA (Linn.). Brünnich's Murre.

Specimens secured in McCormick Bay, July 22 and August 23.

4. ALLE ALLE (Linn.). Little Auk.

A number secured at Cape York, July 22.

One immature specimen secured Sep. 3, 1892, at Gothaub.

9. STERNA PARADISÆA Brünn. Arctic Tern.

Several secured in McCormick Bay, August 1–4.

10. SOMATERIA MOLLISSIMA BOREALIS Brehm. Greenland Eider.

A large series of females is in the collection from Duck Island.

11. TRINGA MARITIMA Brünn. Purple Sandpiper.

Two secured at Disko, July 16.

12. ÆGIALITIS HIATICULA (Linn.). Ring Plover.

One from McCormick Bay, Aug. 4.

13. LAGOPUS RUPESTRIS REINHARDTI (Brehm). Reinhardt's Ptarmigan.

Obtained at Disko, July 16.

14. FALCO ISLANDUS Brünn. White Gyr falcon.

Two specimens obtained from natives.

15. FALCO RUSTICOLUS Linn. Gray Gyr falcon.

One specimen obtained from natives. The one secured by the West Greenland Expedition in 1891 was accidentally referred to *F. r. gyrfalco* in my paper.

16. CORVUS CORAX PRINCIPALIS Ridgw. Northern Raven.

A fine specimen shot on McCormick Bay, Aug. 4.

17. PLECTROPHENAX NIVALIS (Linn.). Snow Bunting.

A number collected at Disko, July 16.

18. CALCARIUS LAPPONICUS (Linn.). Lapland Longspur.

Several specimens taken with the above.

19. SAXICOLA ŒNANTHE (Linn.). Wheatear.

One taken at Disko, July 16.

ARCHÆOLOGICAL WORK IN OHIO.

By Gerard Fowke.

Excavation of a Mound in Pike County, Ohio.[1]

On the farm of W. M. Volgamore, three and one half miles south of Piketon, is the largest mound in the Scioto Valley between Chillicothe and the Ohio River except one four miles south of the "High Banks" in Ross County. It stands on the third of four terraces bordering the river here, the first being regularly and the second occasionally overflowed. A mile below are two earthen enclosures, one square the other circular, each containing between fifteen and twenty acres and connected by parallel walls. Many other remains exist in the county, notably the much-mentioned "Graded Way," which, however, is mostly a natural formation.

The mound has an elliptical base 130 × 110 feet, the longer axis north and south, and its altitude while intact was fully 18 feet. In 1894 the owner scraped off the upper portion, leaving it a truncated cone whose top was about seven feet above the surrounding level. He also scraped a narrow trench across the middle to within three feet of the bottom. At this depth he reports finding two skeletons with some shell beads and two copper bracelets. He went no farther partly to compression of the earth by the weight of the structure, and partly to the increase and looseness, from cultivation, of soil in the field.

The mound presented no peculiarity of construction; its erection had been practically continuous, at least to the height at which this excavation began, for there was neither line of demarcation in the small masses of dumped earth composing it, nor any trace of vegetable growth such as would take place if the work were interrupted. Several sorts of earth entered into its composition, mostly like that immediately around, though it contained some that is not to be found, superficially, nearer than 300 or 400 yards away ; such may, however, occur closer at hand beneath the surface. A small part of it was gathered where leaves or grass had recently been burned off.

The bones mentioned by the owner were found at the depth he indicated; and other fragments were found below them as far as to the bottom of the mound, scattered through earth that plainly had been disturbed since first deposited. The men who did the scraping, however, insist they did not go so deep, neither was.any digging done in the trench they made; if this be true, these lower bones must have been thrown promiscuously, mingled with earth, into a hole dug by the builders of the mound when it had reached a height of three or four feet.

Nineteen feet north of assumed center the skeleton of a young child was found eighteen inches above the original surface. An excavation measuring six feet east and west, by four feet north and south, had been made when the mound, or this portion of it was less than three feet high, and lined with a thin layer of bark or wood which extended beyond it on every side; the bottom was quite irregular except in the north-west corner where a space had been leveled barely large enough to afford a resting place for the body, which lay extended on the back with head to the east. With the bones of the neck were 65 copper beads; these had been strung on vegetable fiber, along with small disk shell beads, the latter too soft for recovery. On the right wrist were two small copper bracelets.

Nothing else was found above the natural surface. Below the top soil is black loam a foot deep, resting on a stratum of hard, gravelly red earth two feet thick, below which is the gray sand whose bottom has never been found. This definite arrangement made it easy to ascertain the aims and methods of the builders.

The burials within the mound were only incidental, and had no part in the original purpose for which it was erected. It had been designed to cover only two graves. The first of these had its axis almost coincident with a radius extending nearly northeast from the center stake. At eight feet to each side of this line began a thin seam of decayed wood which sloped uniformly toward the axis till it reached a depth of two feet at four and one-half feet from its place of beginning; the earth below it had never been disturbed, while that above it had been dumped in to restore the level. At this distance it came to the edge of a pit seven feet in width dug one foot into the gray sand, with walls vertical or in some places slightly overhanging on account of the caving-in of the loose material while the work was progressing. In the bottom of the hole (four feet deep) had been placed two to three inches of the red gravel earth, on which lay three to four inches of gray sand, thus reversing their proper order; above this came the seam of decayed wood extending entirely across the excavated space to the natural surface, as mentioned above; next in order was a thin layer of burned earth, ashes, and charcoal reaching from the shoulders to the knees, and slightly beyond the frame on each side of a skeleton nearly six feet long, which lay extended on the back, with feet toward the center of the mound. On each wrist were two small copper bracelets; about the waist, as if belonging to a belt, was nearly a pint of disk shell beads, some of them being too soft to save; between the femurs were a few Marginellas; about the neck were eleven cylindrical or barrel-shaped was partly decayed, it was covered with a small heap of dark earth immediately preliminary to beginning the mound.

Each end of the grave was followed to the red gravel, found at two feet from the head and the same distance from the feet of the skeleton. It could not be ascertained whether the same slope continued outward from these points as from the sides; for the eastern end was three feet beyond the bank surrounding the area being examined, making it dangerous to follow farther; while at the other end nothing could be made out with certainty, as other operations, carried on about the same time, had encroached on this space.

Figure 1 shows a cross-section; and Figure 2 a longitudinal section of so much as was definitely outlined.

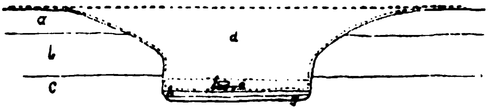

FIG. 1. Cross section, first grave. Volgamore mound.

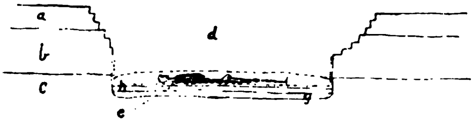

FIG. 2. Longitudinal section, first grave. Volgamore mound.

a. Black soil, 1 foot.
b. Red gravel, 2 feet.
c. Gray sand, bottomless.
d. Mixed earth filling grave and continous with that of the mound above.
e. Ashes; charcoal, and burned earth. 1 inch thick.
f. Skeleton.
g. Red gravel, 2 to 3 inches thick (deposited).
h. Gray sand, 3 to 4 inches thick (deposited).
- - - - (Dotted lines.) Decayed wood and bark, varying in thickness from a streak to 6 inches.
· Zig-zag line in Fig. 2 denotes limit of certainty regarding structure.
Scale: one-ninth of one inch equals one foot.

The second grave was by far the largest that has been recorded in this region. Its dip began on the south side at the margin of the forty-foot circle cleared out; on the north side, a foot south and two feet west of the assumed center mark of the tumulus. The outline was tortuous, but could easily be traced by the decayed wood which had lined it, or by the difference in color and consistency of the earth on either side. When fully exposed, by removal of the top soil around it, it formed an irregular ellipse with a narrow prolongation toward the east. Its entire length was 27 feet on a line almost exactly east and west; its maximum breadth nineteen feet. On the east, north, and south sides, the dip was gradual as in the first grave; but on the west side it was abrupt the entire depth. From near the top of the red gravel, except at the east end where a more gradual slope was left to facilitate the passage of the aboriginal undertakers, the walls were carried directly downward four feet into the gray sand, forming a pit, measuring on the bottom, sixteen feet from east to west, ten feet from north to south, and seven feet deep from the surface. In this, midway between the sides but a little nearer the western end, lay a skeleton about six feet long, extended on the back, head east, arms by the sides, left hand under the hip. The skull was broken by pressure of the earth. About the neck were a few disk beads, and just above the knees a few Marginellas, all very soft. On each forearm were three copper bracelets, one large and two small. One of the larger was so corroded as to fall in two; it was not made of a solid rod, as is usual, but of sheet copper rolled into a cylinder and bent to the desired form. [See note.]

There was no trace of cloth or skins, except adherent to the bracelets, unless the soft, loose, black earth about the bones was due to decay of such material. A thin seam of bark above the body reached a little to each side, but none had been placed beneath it.

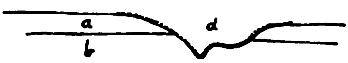

FIG. 4.

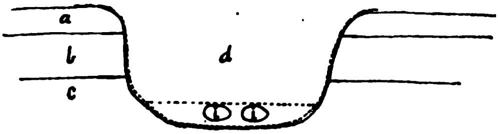

FIG. 5.

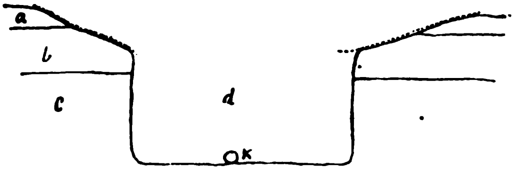

FIG. 6.

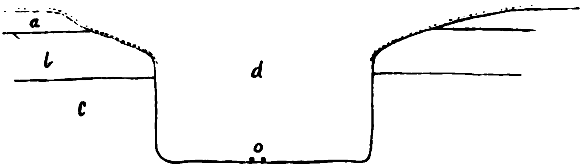

FIG. 7.

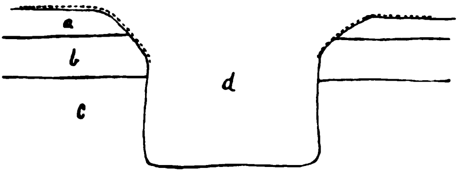

FIG. 8.

FIGS. 4–8. Cross sections at intervals of five feet. Large grave, Volgamore Mound. One-ninth of one inch equals one foot.

a. Black soil, 1 foot.
b. Red gravel, 2 feet.
c. Gray sand, bottomless.
d. "Dumped" earth, continuous to top of mound.
i, *i*. Mingled red and gray, "dumped."
k. Head of skeleton.
o. Legs of skeleton.
.--- (Dotted line) Decayed wood or bark.

NOTE.—During extended researches in the Florida mounds a considerable collection of objects of copper, almost exclusively ornaments, has been gathered. These ornaments, with the exception of several heavy beads, are of thin sheet copper. The only other objects of copper not purely ornamental are piercing implements, sometimes pointed at both ends, and these a careful examination shows usually to be made of sheet copper hammered around and around on itself. It is interesting to note that in Ohio, a region where objects of solid copper are of not infrequent occurrence, a use of sheet copper similar to that seen in Florida is observed.

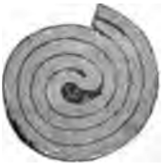

FIG. 9. Section of copper bracelet. (Twice actual size.)

A number of the bracelets found by Mr. Fowke, by their weight, lighter than their size would indicate, seem to be of sheet copper. Fig. 9 gives a section of the bracelet. once enlarged.

C. B. M.

THE CALDWELL MOUND.

Where the Scioto River passes from Pike in Scioto county the terraces bordering it are reduced to two; the first is subject to overflow, while the second marks the highest level at which drift was deposited in this vicinity. A few hundred feet south of the county line, sixteen miles from the Ohio River, on the farm of Mr. S. A. Caldwell, a mound nine feet high and seventy-five feet in diameter at the base stood on the brink of the higher terrace; in the same field are two smaller mounds: and skeletons with pottery and other relics have been found near the surface in excavating for gravel along the slope.

Traces or fragments of human remains were found in six places. At one foot above the bottom, four feet south, and two feet west of the center, was a skull, the bones belonging with it extending southward. At the same level, five feet south, eight feet west of center was a skull stained with hematite; there were also traces of bone six inches above the last. At three and one-half feet above the bottom, ten feet east of the center, was a skull which seemed to have been placed with the face uppermost; three feet west of it, and six inches higher, with no trace of other bones in the intervening space, was a pelvis with leg bones extending southward from it but not parallel; immediately beneath, was a dark line extending entirely across the mound, showing that the work had been stopped for a time at this height; the body or skeleton had been laid on what was then the top of the mound, covered with bark on which was thrown a foot of earth running to a feather-edge a foot west of center. After this, another interval in the labor followed, as shown by a similar line. A body had then been laid on the summit, with the head six and one-half feet east of the center, the feet toward the west. On the skull were several pieces of mica, some of them trimmed to a crescentic outline, and a small, very smooth, sandstone ornament resembling a fiddle bridge in shape. The last skull discovered was six feet above the bottom, eight feet south of the center; it, also, had mica lying on it, some cut like that above mentioned. All the bones found were so soft as to fall to pieces on exposure; and most of them were so decayed that they could be traced only as a streak or thin layer by their color.

When the bottom was reached, the result was disappointing; there was no trace of a grave or other form of burial in or on the soil. A line of soft earth which appeared to form the edge of an excavation, proved to be only a narrow trench 8 to 12 inches wide at the top, somewhat narrower at the bottom, and not more than a foot deep, surrounding an irregular quadrilateral space about twenty feet across. A considerable part of the undisturbed surface now exposed was covered with a layer of ashes and charcoal, containing many small fragments of burned animal bone, but no pottery fragments or other art products. It varied from a thin streak to a layer of 3 or 4 inches; where it was heaviest the earth beneath was considerably burned. Many post-holes were found, some five or six inches in diameter and about two feet deep, others a foot in either dimension;

the parts were burned prior to the depositing of at least some of the ashes, for the latter extended in an unbroken layer over the holes, except in three or four places where the posts were left projecting somewhat above the surface, as shown by the hollow molds in the body of the mound which had packed around them before their decay. These molds were lined with the charcoal from the burned stumps. The trench had been dug through the ashes, except where it extended beyond them on the west side; but their straight margin here as contrasted with the curved outline in other parts, and the abrupt change of direction at the northwest corner, indicate that they had been swept or scraped away on this side before the digging began.

In a mass of ashes about four inches thick, four to six feet east of the center, were many small fragments of bones of a child, burned until nearly destroyed; nine feet south, three feet east of the center were a few fragments of bones of an adult, similarly burned. Both deposits were lying on the natural surface in the bed of ashes.

No explanation or interpretation of these facts will be attempted; the reader must form his own conclusions. There may have been some sort of a building of which the posts formed a part; but they do not seem well arranged for such purpose, and no others exist within the excavated space, for every foot of it was carefully examined. The ash-bed, if the fact of a house be admitted, may be due to ordinary domestic life; but this would not account for the cremated human bones. Nor could the latter be so thoroughly charred unless intentionally burned, for, although they were in a mass of ashes, there was no indication of any considerable amount of heat about where they were found.

To repeat :—The posts were burned off, as is proven by the charcoal found in the holes where they stood, and especially in the casts above the ashes; the latter were deposited, at least in part, after such burning as is shown by their continuity above the holes; and the trench was dug still later, because the ashes came up to its margin on both sides and stopped there, and in two or three places the yellow earth from its bottom lay directly upon them. Further, only a short period of time was embraced in these stages, for the projecting ends of the posts were still solid enough when the mound was built for the earth deposited over and around them to pack so firmly that it held its shape after they had disappeared. Finally, the construction of the mound was intermittent.

EXCAVATION OF A LOW MOUND IN PIKE COUNTY.

A mile north of Wakefield, in Pike County, on the Barnes farm, are the enclosures figured by Squier and Davis as the "works in Seal Township." Near the south-east corner of the square enclosure is a mound, now about three feet high and sixty feet in diameter, surrounded by a ditch and embankment. A circle 25 feet across was laid off on the highest part of this and the earth removed to the subsoil.

About eight feet northwest of the center, and 16 inches above the original surface were two or three fragments of human skull; and between three and four feet south of them portions of human femora; these probably were the remains of a body that had been laid extended with head to the north. No other human remains were found in the structure.

Eleven feet south of the center were several small pieces of mica, some of them fragments of trimmed and perforated pieces, others rough flakes split off from a larger piece; on them lay nine flint blocks or cores, evidently raw material for implements; these were partially covered with a large sheet of mica; one of the blocks was chipped into a rude hatchet-form. A foot east of these were two gorgets; one was of close-grained slate, well made, with a single perforation; the other of micaceous sandstone with two perforations. Three feet east of these was a deposit containing a finely wrought flint knife, a rough and a broken arrow-head, a flint block like those first found, and a sheet of mica. These were all at the same level as the human bones found on the opposite side of the mound; but there was no evidence of a burial at the place they occurred. The flint blocks were irregular fragments of larger nodules, with a chalky exterior, a coating of silicate of lime, and the concretionary structure well marked in some. No flint of this character has ever been found in place in Ohio; a similar stone occurs abundantly near the Wyandotte Cave in southern Indiana, but is not known to exist at a nearer point.

NOVEMBER 5.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Thirty-two persons present.

The death of Charles M. Thomas, M. D., a member, was announced.

DR. S. G. DIXON made an announcement of the curative effect of the subcutaneous injection of a saturated solution of taurin in an aggravated case of Acne pustulosa. (No abstract).

NOVEMBER 12.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Thirty persons present.

NOVEMBER 19.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Ninety-three persons present.

A paper entitled "The Bees of the Genus Perdita F. Smith," by T. D. A. Cockerell, was presented for publication.

NOVEMBER 26.

SYNOPSIS OF THE NORTH AMERICAN SPECIES OF GORYTES Latr.

BY WILLIAM J. FOX.

GORYTES Latreille.

Gorytes Latreille, Hist. Nat., XIII, p. 308, 1805.
Hoplisus Lepeletier de St. Fargeau, Ann. Soc. Ent. France, I, p. 56, 1832.
Euspongus Lepeletier de St. Fargeau, ibid.
Dienoplus Fox, Proc. Acad. Nat. Sci., Phila., p. 549, 1893.

For the full synonymy of this genus see Handlirsch's monograph.*

FEMALES.

Antennæ strongly clavate. (Eyes large, strongly convex and strongly converging toward clypeus; tarsi graceful and long; mesosternum not carinated.) . . . . . . *moneduloides.*
Antennæ not strongly clavate 2
2. First segment of abdomen coarctate at apex 3
First segment of abdomen not coarctate, sessile or subpetiolate 5
3. First recurrent nervure received by the first submarginal cell; wings hyaline throughout; submedian cell (anal area) of posterior wings terminating *much* before the origin of the cubital nervure; size small . . . . *bipunctatus.*
Both recurrent nervures received by the second submarginal cell; wings with a fuscous cloud; submedian cell (anal area) not or terminating but little before the origin of the cubital nervure; size larger 4
4. Enclosure of middle segment striated at base only; head, thorax, abdomen and legs spotted with yellow . . *mellinoides.*
Enclosure of middle segment striated throughout; entirely black, except the second abdominal segment which is rufous . . . . *rufocinctus.*
5. Wings clear, without the usual fuscous spot 6
Wings more or less fuscous, always with a cloud in the vicinity of the marginal and submarginal cells 8
6. First abdominal segment subpetiolate, the apical margins of all the segments broadly clothed with pale pubescence.
. . . . *eximius.*
First abdominal segment sessile 7

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* Sitzungsberichte der k. k. Akademie der Wissenchaften, Wien, Mathematisch-naturwissenschaftliche Classe, Abtheilung I, XCVII Bd., p. 317.

7. Submedian cell of posterior wings terminating *much* before the origin of the cubital vein; thorax and legs black, not spotted; abdomen reddish in greater part, not marked with yellow; enclosure of middle segment striated basally. . . . . *pictifrons.*

Submedian cell of posterior wings not, or but slightly, terminated before the origin of the cubital vein; thorax and legs spotted with pale yellow; hind femora and two basal segments of abdomen, reddish, the abdominal segments above with pale yellow on their apical margins; enclosure of middle segment striated throughout . . . . *Coquillettii.*

8. Second ventral segment not at all angular 12

Second ventral segment prominently angular 9

9. Middle segment coarsely rugose throughout 11

Middle segment not rugose, the furrow forming the enclosure broad, crossed longitudinally by coarse ridges; flagellum subclavate (third segment not fasciate; second ventral with very large punctures toward the base) . . . . *nigrifrons.*

10. Palpi dark; fourth dorsal abdominal segment without a fascia, or with a very short one . . . . *mystaceus.*

Palpi in part yellow; fourth dorsal segment with a complete fascia . . . . *campestris.**

11. Eyes converging but little toward the clypeus 12

Eyes distinctly converging toward the clypeus 20

12. At the most the middle segment and first segment of abdomen rufous; space between base of clypeus and fore ocellus as broad, or nearly so, as long 13

Entirely rufous, with yellow markings, the yellow bands of abdomen unusually broad; middle segment yellow; space between base of clypeus and anterior ocellus distinctly

15. Last dorsal segment yellow 16

Last dorsal segment black 17

16. Legs black; first dorsal segment not fasciate . . . . *fuscus.*

Legs reddish, except base; first dorsal segment fasciate. *pygidialis.*

17. Mesosternum anteriorly sharply and strongly carinated; pygidium broad, not more than twice as long as its width in the middle 18

Mesosternum anteriorly neither sharply nor strongly carinated; pygidium long, narrow, somewhat more than twice as long as its width in the middle (form very robust) . *costalis.*

18. No distinct fuscous cloud in the second discoidal cell; front distinctly longer than broad; coxæ and trochanters reddish, rarely obscure 19

A distinct fuscous cloud filling the apical third of second discoidal cell; front fully as broad as long; coxæ, trochanters and femora in part, obscure . . . . *nebulosus.*

19. Wings, excepting the usual fuscous cloud in the vicinity of the marginal cell, hyaline; enclosure of middle segment with 14–16 close-set ridges . . . . *confertus.*

Wings fuscous, the cloud in the vicinity of the marginal cell darker; enclosure of middle segment with 10–12 well-separated ridges . . . . *denticulatus.*

20. Middle segment more or less coarsely sculptured 21

Middle segment not coarsely sculptured, smooth 30

21. Posterior surface of middle segment coarsely sculptured . . . 22

Only the basal enclosure of middle segment coarsely sculptured entirely or in part 27

22. Wings with a strong yellow tinge on basal two-thirds 23

Wings not yellow basally 25

23. Sculpture of enclosure of middle segment consisting of even, radiating ridges; flagellum either entirely black, or with basal joints reddish 24

Sculpture of enclosure of middle segment coarsely and irregularly rugose; flagellum yellow beneath, black above (markings bright yellow; first joint of flagellum distinctly shorter than the two following united) . . . . *asperatus.*

24. Flagellum long, scarcely clavate, the first joint distinctly shorter than the two following united; clypeus entirely black; markings yellow . . . . *atrifrons.*

Flagellum short, subclavate, the first joint but little longer than the following two united; clypeus whitish basally; marking whitish . . . . *albosignatus.*

25. Femora, except apex, and the tibiæ in part, black; flagellum yellow beneath, black above 26

Femora in greater part, tibiæ and tarsi, reddish; flagellum black, basal joints reddish (middle segment with two large yellow spots) . . . . *decorus.*

26. Flagellum long, setaceous; scape elongate much more than twice as long as broad at apex; middle segment with two yellow spots . . . . *atricornis.*
Flagellum shorter, a little clavate; scape short but little more than twice as long as its width at apex, middle segment not spotted . . . . *canaliculatus.*
27. Extreme base of enclosure of middle segment only striated . . 28
Entire enclosure covered with striæ 29
28. Wings scarcely yellow the stigma testaceous; markings palish yellow; dorsal segments 4 and 5 impunctate . . . . *simillimus.*
Wings with a tolerably yellow tinge, the stigma yellow; markings bright yellow; dorsal segments 4 and 5 with scattered punctures . . . . *angustatus* var.
29. Antennæ with the flagellum distinctly thickened apically, yellowish beneath, at least basally . . . . *angustatus.*
Antennæ slender, the flagellum setaceous, obscure testaceous beneath . . . . *nevadensis.*
30. Dorsal segments 4 and 5 impunctate 31
Dorsal segments 4 and 5 with distinct, scattered punctures . . 35
31. Suture between dorsulum and scutellum foveolate 32
Suture between dorsulum and scutellum not foveolate . . . . *phaleratus.*
32. Wings, in greater part, dark fuliginous 33
Wings yellow ferruginous . . . . *venustus.*
33. Wings clear at apex; first two segments almost entirely yellow . . . . *abdominalis.*
Wings entirely fuliginous; only the first segment spotted with yellow 34
34. Head and thorax black, ornamented with yellowish; clypeus black; first dorsal segment entirely yellow . . . . . . *Smithii.*

3. Submedian cell of posterior wings terminating before the origin of the cubital vein 4
Submedian cell of posterior wings not terminating before the origin of the cubital vein 8
4. Second ventral segment prominently angular 6
Second ventral segment not angular 5
5. First abdominal segment subpetiolate, apical margins of the segments broadly margined with pale pubescence; antennæ short . . . . *eximius.*
First abdominal segment sessile, the abdomen red in part, not pubescent; antennæ long, slender . . . . *pictifrons.*
6. Middle segment coarsely rugose throughout 7
Middle segment not rugose, the furrow forming the enclosure wide, crossed longitudinally by strong ridges; antennæ shorter than head and thorax, joints 2-6 of flagellum strongly rounded-out beneath . . . . *nigrifrons.*
7. Antennæ very long; palpi obscure . . . . *mystaceus.*
Antennæ shorter; palpi in part yellow . . . . *campestris.**
8. Middle segment more or less coarsely sculptured 9
Middle segment not coarsely sculptured, smooth 31
9. Dorsulum strongly punctured 10
Dorsulum not strongly punctured 20
10. First abdominal segment subpetiolate; last ventral segment bifid 19
First abdominal segment not subpetiolate 11
11. Fifth ventral abdominal segment armed with a strong prominence at each side. (See fig. 1.) . . . . *confertus.*
Fifth ventral segment unarmed 12
12. Mesosternum dentate laterally (entirely red, with pale markings) 13
Mesosternum not dentate 14
13. Middle segment not at all yellow; abdominal fasciæ narrow; fuscous cloud of fore wings not extending beyond the apex of marginal and third submarginal cells . . . . *dentatus.*
Middle segment yellow in greater part; abdominal fascia unusually broad; fuscous cloud of fore wings extending to apex of wing . . . . *diversus.*
14. Eighth and ninth joints of flagellum spinose beneath 16
Eighth and ninth joints of flagellum not spinose, at the most tuberculate 15
15. Enclosed space on middle segment smooth; middle segment and first and last abdominal segments more or less red; legs entirely red . . . . *tricolor.*
Enclosed space on middle segment distinctly striated; middle

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*See foot note, p. 518.

segment and first abdominal segment not red, the last segment yellow . . . . *pygidialis.*

16. Clypeus with a bunch of long, curved hairs in each angle . . . 17

Clypeus with the hair at angles not very long, not curved or bunched 18

17. Spine of ninth joint of flagellum large and distinct; head as wide as thorax; legs black and yellow . . . . *hamatus.*

Spine of ninth joint of flagellum small, indistinct; head small, narrower than thorax; legs red and yellow . . . *microcephalus.*

18. Wings fuscous, the cloud in the vicinity of the marginal cell darker; middle segment with two yellow spots . . *denticulatus.*

Wings, except the usual fuscous cloud in the vicinity of the marginal cell, subhyaline; middle segment not spotted . . . . *barbatulus.*

19. Wings entirely yellowish, the marginal cell scarcely darker; antennæ entirely rufous. Length 11 mm . . . . . *laminiferus.*

Wings slightly yellowish basally, the marginal cell distinctly fuscous; antennæ dark above . . . . *mirandus.*

20. Last ventral segment emarginate or bifid, flagellum rather short, the last four joints enlarged, somewhat emarginate beneath (wings without a fuscous cloud) . . . . *insolitus.*

Last ventral segment with a spine or process 21

21. Posterior surface of middle segment coarsely sculptured . . . 22

Only the basal enclosure of middle segment coarsely sculptured 27

22. Eyes very broad, their width equalling more than half their length, the space between them at base of clypeus about equal to the length of the latter in the middle; enclosure of middle segment irregularly rugose . . . . *asperatus.*

Eyes as usual, their width scarcely equalling half their length, the space between the eyes at base of clypeus

28. Flagellum not thickened apically; wings scarcely yellowish. . . . . *simillimus.*
Flagellum thickened apically, wings yellowish basally. . . . . *angustatus* var.
29. Wings distinctly yellowish; femora entirely yellow beneath. . 30
Wings scarcely yellowish; femora black basally beneath. . . . . *simillimus* var.
30. Flagellum thickened apically . . . . *angustatus.*
Flagellum setaceous . . . . *nevadensis.*
31. Dorsal segments 4 and 5 impunctate 32
Dorsal segments 4 and 5 with distinct, scattered punctures . . 36
32. Suture between dorsulum and scutellum foveolate 34
Suture between dorsulum and scutellum not foveolate 33
33. Flagellum rather long, the joints about twice as long as broad, prominently rounded-out beneath; wings with a yellowish cast . . . . *phaleratus.*
Flagellum shorter, somewhat subclavate, the joints (basal ones excepted) not twice as long as broad, not rounded-out beneath; wings black, apex pale . . . . *propinquus.*
34. Wings in greater part dark fuliginous 35
Wings yellow, ferruginous . . . . *venustus.*
35. Wings clear at apex; middle segment spotted with reddish. . . . . *abdominalis.*
Wings entirely fuliginous (head and thorax black) . . . *Smithii.*
36. Antennæ rather long, reaching at least to apex of scutellum. . 37
Antennæ shorter, not reaching to apex of scutellum, subclavate (middle segment spotted with rufous) . . . *rufomaculatus.*
37. Abdomen with very broad fasciæ; middle segment spotted with yellow; basal joints of flagellum reddish . . . . *fasciatus.*
Abdomen with narrow fasciæ; middle segment not spotted; basal joints of flagellum black above . . . . *bipartitus.*

1. Gorytes moneduloides Pack.

Gorytes moneduloides Packard, Proc. Ent. Soc., Phila., VI, p. 424. ♂.
Gorytes Belfragei Cresson, Trans. Am. Ent. Soc., IV, p. 224. ♀

Georgia, Louisiana, Texas. A ♀ specimen, from Mexico, differs by the dark legs, absence of yellow spots of scutellum, and the band of first dorsal abdominal segment is broken into two spots.

2. Gorytes bipunctatus Say.

Gorytes bipunctatus Say, Narr. Exped. St. Peter's River (Keating) II, Zool., p. 338.
Lestiphorus bipunctatus Dahlbom, Hym. Eur., I, p. 157.
Euspongus bipunctatus Dahlbom, ibid., p. 480; Cresson, Synopsis, p. 117.
Gorytes bipunctatus Handlirsch, Sitzb. k. k. Akad. Wissensch., Wien, Mathem.-naturw. Classe, Abth. I, Band XCVII, p. 355, ♀

Found throughout the United States, except in the States north and northeast of Pennsylvania. The male is similar to the female, being marked the same. It agrees with the group characters given by Handlirsch, on p. 347 of his work, except that the first recurrent vein is received by the second submarginal cell, instead of the first as in the female.

The spots on the second abdominal segment are occasionally absent, or enforced by the presence of an additional pair on the third segment.

3. Gorytes rufocinctus Fox.

Gorytes rufocinctus Fox, Can. Ent., 1892, p. 153, ♀

Washington State. This may be the female of *piceus* Hdl., which I have not seen.

4. Gorytes piceus Hdl.

Gorytes piceus Handlirsch, l. c., p. 455, ♂

British Columbia. Unknown to me and may be the ♂ of *rufocinctus*. The face, antennæ and legs are said to be more or less yellow, and the second dorsal laterally and the second ventral rufobrunneous.

5. Gorytes mellinoides n. sp.

♀.—Eyes diverging toward the clypeus, the latter convex, its anterior margin a little incurved medially; antennæ long, slender, the first joint of flagellum longer than the scape and pedicellum united; suture between dorsulum and scutellum foveolate; mesosternum carinated anteriorly, with the epimerum and episternum of the mesothorax not separated; middle segment with the enclosure beneath, spot at each side of first dorsal segment, an oblique spot on each side of the second, apical margin of the third dorsal and second ventral, all yellow; flagellum beneath, tegulæ and greater part of legs testaceous. Length 9 mm.

Texas (Belfrage). Collection of U. S. National Museum.

6. Gorytes mystaceus Linné.

Sphex mystacea Linné, Fauna Suecica, p. 412.
Gorytes mystaceus Handlirsch, l. c., p. 367, pl. II, f. 15; pl. III, f. 6, ♀ ♂. For full synonymy see Handlirsch, l. c.

Handlirsch records this species from America. I have only seen European examples.

7. Gorytes campestris Müll.

Vespa campestris Müller, Linne's Natursystem, V, II, 883.
Gorytes campestris Handlirsch, l. c., p. 372, ♀ ♂, pl. I, f. 1, 25, 28; pl. II, f. 14. For full synonymy see this author.

Also recorded from North America by Handlirsch. I doubt the occurrence of either *mystaceus* or *campestris* in America, the specimens seen by Handlirsch being very likely labelled erroneously.

8. Gorytes nigrifrons Smith.

Gorytes nigrifrons Smith, Cat. Hym. B. M., IV, p. 368, ♀
Gorytes Bollii Cresson, Tr. Am. Ent. Soc. IV, p. 225 ♀
Gorytes nigrifrons Handlirsch, l. c., p. 376.

Nova Scotia (Smith); North Carolina, in Collection of U. S. Nat'l Museum; Texas. Through the courtesy of Mr. Samuel Henshaw, I have examined the type of *G. Bollii* Cr., and find it agrees exactly with Smith's description of *nigrifrons*, which therefore corroborates Handlirsch's action in uniting the two, although he had seen specimens of neither. The wide furrow, which forms the enclosure of middle segment, distinguishes this species from any of its congeners, and by which character the ♂, heretofore unknown, may also be separated from either of the two preceding species.

9. Gorytes fuscus Tasch.

? *Gorytes vespoides* Smith, Ann. Mag. Nat. Hist. XII, p. 407, ♀ 1873.
Hoplisus fuscus Taschenburg, Zeitsch. f. d. ges. Naturw., p. 368, 1875.

Recorded from Connecticut by Handlirsch. Occurs in Mexico and Brazil. The ♂, which I have not seen, is said to be distinguished from its allies by its simple, non-emarginate, non-spinose or tuberculate antennæ, and by the first segment being not fasciate.

10. Gorytes confertus n. sp.

♀.—Eyes toward the clypeus very slightly converging; antennæ a little clavate, the scape longer than the pedicellum and first joint of flagellum united, the latter joint much longer than the second; clypeus with anterior margin truncate, not barbate laterally; front strongly and sparsely punctured; dorsulum with large sparse punctures, those of the mesopleuræ less strong; suture between dorsulum and scutellum foveolate; episternum and epimerum mesothoracis indistinctly separated, the mesosternum sharply carinated anteriorly and laterally; middle segment posteriorly with large punctures, the enclosure rather large, well-marked, with 14-16 close-set, ridges or striæ; legs stout, the tibiæ spinose, fore tarsi with a strong comb; wings clear, except the usual fuscous cloud, which includes the marginal and part of the second and third submarginal cells, nervures brown, stigma yellowish, submedian cell of posterior wings terminating at the origin of the cubital vein; abdomen strongly punctured, particularly the second ventral segment, pygidial area with large, elongate punctures, ridged laterally. Black; clypeus, labrum, mandibles except apex, scape, flagellum beneath, inner and posterior orbits, sometimes a line across the vertex, line on pronotum, tubercles, spot behind them, scutellum, postscutellum sometimes, a broad fascia at apex of dorsal segments 1-5, and apex of second and third ventrals more or less, all yellow; legs, including coxæ, entirely reddish-testaceous. Length 8–8½ mm.

♂.—Resembles ♀ as to coloration but has a strong grayish sericeous reflection over the entire insect, and the tibiæ and tarsi are more or less yellow. Eyes strongly con-

varies from back with the middle segment red to entirely rufous. The yellow ornamentation is usually the same in both forms, however.

12. Gorytes ruficornis Prov.

Gorytes ruficornis Provancher, Add. Hym. Quebec, p. 273, ♀ ♂.

California (Provancher). Unknown to me. Seems to be near *tricolor*.

13. Gorytes diversus n. sp.

♀.—Eyes parallel within; front with shallow punctures; space between the fore ocellus and base of clypeus distinctly longer than wide; clypeus strongly convex in middle; antennæ rather longer than usual for species of this section, the flagellum but little thickened apically, its first joint more than one-third longer than the second, scape long and narrow, longer than the following two joints united; dorsulum, mesopleuræ and middle segment posteriorly with large, separated punctures; suture between dorsulum and scutellum foveolate; mesosternum carinated anteriorly, not laterally, the epimerum and episternum mesothoracis indistinctly separated; enclosure of middle segment well marked, with about 18 striæ; tibiæ and tarsi spinose, anterior tarsal comb well developed; wings with a fuscous cloud including the marginal, second and third submarginals and part of the third discoidal cells, a fuscous stain along the basal nervure, stigma yellowish, nervures black; abdomen strongly punctured, particularly ventrally, pygidial area with strong punctures, scarcely ridged laterally. Rufous; anterior and posterior orbits, the former narrowly, pronotum, greater part of mesopleuræ, scutellum, postscutellum, middle segment almost entirely, spot on medial and hind coxæ; dorsal segments of abdomen except extreme base of second and the last usually, and greater part of ventrals 2-4, or 5, all yellow; apical antennal joints fuscous. Length 8½–9 mm.

♂.—Colored like the ♀, except in the following points: clypeus, mandibles, inner orbits broadly, scape beneath, dorsulum at sides, and the legs, more or less, yellow; rufous on middle segment and abdomen more extended. Fuscous cloud reaching apex of wing; clypeus not barbate laterally; antennæ shorter and stouter, joints of flagellum rounded beneath, 8–10 subemarginate; eyes very slightly converging beneath; enclosure of middle segment smaller than in ♀, with about 14, rather feeble, striæ; mesosternum dentate laterally. Length 8 mm.

Los Angeles, California (Coquillett). In collection U. S. Nat'l Museum.

14. Gorytes dentatus Fox.

Gorytes dentatus Fox, Can. Ent., XXV, p. 116, ♂.

Grand Canõn, Arizona (Townsend). This species has no yellow on the middle segment, and the yellow markings of abdomen are narrow, wanting entirely on three last segments.

15. Gorytes pygidialis n. sp.

♀.—Eyes diverging slightly toward clypeus; the latter scarcely convex; front strongly punctured, with a strong central furrow; scape about as long as the following two joints united, flagellum somewhat thickened apically, the first joint about one-third longer than the second; dorsulum, mesopleuræ and middle segment with large separated punctures, closest on posterior face of middle segment whose enclosure is scarcely defined, with about 16 coarse ridges; mesopleuræ indistinctly carinated, epimerum and episternum mesothoracis indistinctly separated; tibiæ and tarsi strongly spinose, the anterior tarsi with a distinct comb; wings clear, except the fuscous cloud which includes the marginal, upper portion of second and third submarginals, thence extending to the basal nervure bordering the first submarginal and first discoidal cells; abdomen strongly punctured, pygidial area long and narrow, ridged laterally and with large punctures. Black; clypeus in part or entirely, mandibles except apex, scape more or less, inner and posterior orbits, basal

Montana; Colorado (Snow); Las Cruces, New Mexico (Cockerell). The ♀ is very like *costalis*, but is smaller and has the last segment yellow. If the ♂ of *costalis*, when discovered, presents no better characters for distinction than those of the ♀, the two will probably have to be united.

16. Gorytes costalis Cress.

Gorytes costalis Cresson, Tr. Am. Ent. Soc., IV, p. 225, ♀.

Texas; Algonquin (Nason) and Peoria, Illinois. A specimen from St. Augustine, Florida (Johnson) has the legs entirely reddish testaceous, only the two first segments margined with yellow and the fuscous of the wings is much more extended than is usual. I am indebted to Mr. Henshaw for the opportunity of examining the type of this species.

17. Gorytes hamatus Hdl.

Gorytes hamatus Handlirsch, l. c., p. 403, ♂, pl. 2, f. 17.
Gorytes maculatus Provancher, Le Nat. Can. XXII, p. 140, ♀.

Texas (Belfrage); Coloradó; Dakota; Montana; Washington State; Nevada; Los Angeles, California (Coquillett). This is a variable species both in size and coloration. The middle segment is sometimes bispotted, and the legs may be yellow and black or the femora may be more or less reddish. The spine of the ninth antennal joint is much more distinct in some specimens than in others. Length 7–9 mm.

18. Gorytes microcephalus Hdl.

Gorytes microcephalus Handlirsch, l. c., p. 405, ♂.

Georgia (Handlirsch); Colorado. I have taken it in the latter part of June, in Camden County, New Jersey, but not commonly.

19. Gorytes Pergandei Hdl.

Gorytes Pergandei Handlirsch, l. c., p. 407. ♂.

Virginia and Illinois (Handlirsch). Unknown to me. The middle segment is said to be more coarsely sculptured posteriorly than in its allies, *microcephalus* and *barbatulus*, being "almost cicatricose."

20. Gorytes nebulosus Pack.

Gorytes nebulosus Packard, Proc. Ent. Soc., Phila., VI, p. 424, ♀.

Massachusetts (Packard); New Jersey; Georgia. The front in this species is fully as broad as long, and the pygidium is broader than usual.

21. Gorytes rugosus Pack.

Gorytes rugosus Packard, l. c., p. 427, ♂.

Brunswick, Maine (Packard). Unknown to me. This will, no doubt, eventually prove to be the ♂ of *nebulosus.*

22. Gorytes armatus Prov.

Gorytes armatus Provancher, Add. Hym. Quebec, p. 272, ♂.

Ottawa, Canada (Provancher). Unknown to me. This species is said to have the mandibles spined near the base on "superior" margin. The occurrence of such a character in *Gorytes* is questionable; and it is not unlikely that Provancher has been misled by the lateral bunches of hair, with which the clypeus of the males of this section is furnished, and which frequently present a waxy appearance, thereby resembling a spine to some extent. The removal of this character from consideration suggests the uniting of *armatus* with *rugosus.*

23. Gorytes barbatulus Hdl.

Gorytes barbatulus Handlirsch, l. c., p. 408, ♂.

Illinois and Texas (Handlirsch); Agricultural College, Mississippi (H. E. Weed); District of Columbia. The female specimens, doubtfully referred to *barbatulus* by Handlirsch, belong to *denticulatus.*

24. Gorytes denticulatus Pack.

Gorytes denticulatus Packard, Proc. Ent. Soc., Phila., VI, p. 430, ♂ (non ♀).
Gorytes barbatulus (in pt.) Handlirsch, l. c., p. 410, ♀.

Florida; Georgia; Louisiana; Mexico. Handlirsch is right in

27. Gorytes pictifrons Fox.

Dienoplus pictifrons Fox, Proc. Acad. Nat. Sci. Phila., 1893, p. 549, ♀ ♂.

Washington State. Seems to differ only from *mendicus* by having the enclosure of middle segment striated basally, a character liable to vary.

28. Gorytes mendicus Hdl.

Gorytes mendicus Handlirsch, Ann. k. k. naturh. Hofmuseums, VII, p. 278, ♀.

British Columbia (Handlirsch). Unknown to me.

29. Gorytes Coquillettii n. sp.

♀.—Eyes strongly converging toward the clypeus; the latter rounded behind, its anterior margin a little incurved; front with punctuation indistinct, apparently coriaceous; antennæ short, flagellum clavate, the first and second joints about equal in length, scape short and broad, longer, however, than the two following joints united; dorsulum and mesopleuræ finely and closely punctured; suture between dorsulum and scutellum foveolate; mesosternum not ridged, the epimerum and episternum mesothoracis separated; middle segment finely punctured, the enclosure large, well-defined and covered with about 16, oblique striæ, the central furrow rather broad; legs stout, tibiæ and tarsi spinose, the fore tarsi with a distinct comb; wings clear throughout, nervures and stigma black, submedian cell of hind wings terminating at the origin of the cubital vein; abdomen elongate, the segments not much constricted at the sutures, indistinctly punctured, finely so ventrally, pygidium with strong punctures, margined at the sides. Black; first three or four abdominal segments more or less, and hind femora, except base, reddish, antennæ beneath, clypeus, labrum, mandibles except apex, line on pronotum, tubercles, spot on scutellum, spot at apex of fore and medial femora, short stripe on the medial and hind tibiæ exteriorly, two transverse spots on apical margin of the first abdominal segment and a long, sinuate stripe on each side of the apical margin of segments 2–4, whitish-yellow; tarsi dark; front and dorsulum brownish tomentose, that on clypeus, sides of thorax and in particular the middle segment, silvery. Length 7 mm.

Los Angeles, California, in April (Coquillett). In collection of U. S. Nat'l Museum.

30. Gorytes insolitus n. sp.

♂.—Head rather large; eyes converging toward the clypeus; the latter large, most prominent anteriorly, anterior margin truncate, not barbate, front finely and closely punctured, without a median impressed line; antennæ tolerably stout, flagellum with joints 2–9 tuberculate beneath, particularly the sixth joint, from which joint the flagellum is suddenly thickened; scape short triangular; thorax finely and closely punctured, most strongly on mesopleuræ; metapleuræ striated; suture between dorsulum and scutellum foveolate; mesosternum ridged anteriorly; enclosure of middle segment large, well defined, the striæ coarse, not well marked; hind tarsi thick, scarcely spined, fore tarsi somewhat flattened; wings clear throughout, nervures and stigma black, submedian cell of hind wings terminating a little before the origin of cubital vein; abdomen short and broad, not constricted at the segments, finely punctured; ventrals 3–5 with a prominent transverse fringe of appressed yellow hair, last ventral bifid. Black; clypeus, labrum, mandibles except apex, spot between antennæ, sometimes wanting however, inner orbits, scape, flagellum beneath, line on pronotum, tubercles, a spot behind them, scutellum, dot on postscutellum, apex of femora more or less, tibiæ except within, fore and medial tarsi except last joint, a fascia at apex of segments 1–6, twice emarginate anteriorly and enlarged laterally, and apical margin of second ventral in part, sometimes, all yellowish; middle segment with silvery pubescence; hind tarsi dark. Length 6 mm.

longer than the second, joint 8 excised beneath, joints 9 and 10 much smaller, also excised beneath, the ninth indistinctly so, last joint rather long and slender; dorsulum and mesopleuræ with large, rather shallow punctures; mesosternum carinated laterally and anteriorly; epimerum and episternum mesothoracis distinctly separated; middle segment posteriorly cicatricose, its enclosure very strongly defined, the striæ coarse and rather irregular; legs long, tibiæ and tarsi spinose, fore femora formed into a broad lamina; wings yellowish, including nervures and stigma, submedian cell of posterior wings terminating at the origin of the cubital vein; abdomen with first segment long and narrow, subpetiolate as in *mirandus*, apical segments distinctly punctured, last ventral segment bifid. Black; antennæ entirely and base of wings rufous; clypeus, inner and posterior orbits, face below antennæ, labrum, mandibles except apex, line on pronotum, tubercles, long spot behind them, scutellum, postscutellum, spot on each side of middle segment, and a broad fascia at apex of dorsal segments 1–6 and ventrals 2–4, entirely yellow; last two ventrals reddish; legs variegated with reddish, yellow and black, abdomen tomentose. Length 11 mm.

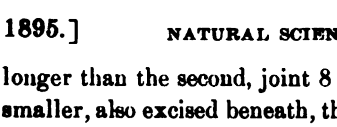

FIG. 2. Fore femur, *Gorytes laminiferus*.

Washington State. Apparently close to *gracilis*, but differs in the enclosure of middle segment being striated throughout, coarse punctures of dorsulum, yellow wings, etc. Handlirsch does not mention the anterior femora in his description of the ♂ of *gracilis*, and it is therefore likely that they are not laminate as in *mirandus* and *laminiferus*.

34. Gorytes atrifrons Fox.

Gorytes atrifrons Fox, Can. Ent., XXIV, p. 151, ♀ ♂.

Nevada.

35. Gorytes albosignatus Fox.

Gorytes albosignatus Fox., ibid. p. 152, ♀ ♂.

Montana; Colorado (Gillette). The specimen from the latter locality, a ♀, measures but 7 mm. The basal spot of clypeus is sometimes divided.

36. Gorytes geminus Hdl.

Gorytes geminus Handlirsch, l. c., p. 478, ♀ ♂.

Virginia (Handlirsch). Unknown to me. The flagellum in both sexes is said to be entirely black, the ♀ thus being distinguished from both *atricornis* and *canaliculatus*. The ♂ has the flagellum joints about twice as long as broad, in which it agrees with *canaliculatus*, but differs thereby from *atricornis* ♂. *G. canaliculatus* (♂) has the flagellum beneath and two spots on middle segment yellow, whereas in *geminus* these parts are said to be black.

37. Gorytes vicinus Hdl.

Gorytes vicinus Handlirsch, Ann. k. k. naturh. Hofmuseums, VIII, p. 279, ♀.

Washington State (Handlirsch). Unknown to me. It is evidently close to *atricornis*; but the wings are said to be strongly tinged with yellow.

38. Gorytes atricornis Pack.

Gorytes atricornis Packard, Proc. Ent. Soc. Phila., VI, p. 428, ♀ ♂.

Canada; Maine; New Hampshire; Massachusetts; Washington State; Nevada. The middle segment may or may not be spotted.

39. Gorytes canaliculatus Pack.

Gorytes canaliculatus Packard, ibid., p. 428, ♀.

Canada. The flagellum of the ♂ is shorter than in *atricornis* and is yellowish beneath, and the enclosure of middle segment has 15–16 even striæ.

40. Gorytes asperatus n. sp.

first segment not striated basally, pygidial area triangular, indistinctly margined at the sides, with large, sparse punctures. Black; clypeus except fore margin, labrum, mandibles except apex, inner orbits, antennæ beneath, line on pronotum, tubercles, spot behind them, scutellum, line on metanotum (postscutellum), small spot on each side of middle segment, femora at apex and anterior pair beneath, tibiæ except a spot within, tarsi except apical joints, a broad fascia on dorsal abdominal segments 1–5, and a spot on the apical margin of second ventral laterally, which at the extreme sides is enlarged and runs toward the base of the segment, all yellow. Length 8 mm.

♂.—Similar to the ♀ as the coloration, but the flagellum entirely black; eyes large strongly converging toward the clypeus, the space between them at the base of the latter about equal to half that at the vertex; clypeus but little shorter than broad; flagellum stout, a little thickened apically, the joints (first two excepted) about twice as long as broad, last joint a little longer than the preceding one; tibiæ and tarsi scarcely spinose, hind tarsi thickened; wings but slightly yellowish basally; greater part of ventral segments yellowish. Length 7–8 mm.

Southern California. Distinguished from *canaliculatus* by the yellowish wings, particularly in the female, irregular sculpture of enclosure of middle segment, and much broader eyes of male, which give the head, seen from the front, a very transverse shape. There are four ♂ specimens before me from Washington State which I refer doubtfully to this species. The yellow markings are more restricted, there being no yellow on the tubercles and middle segment. The markings, also, are a paler yellow.

41. **Gorytes decorus** n. sp.

♀.—Eyes converging toward the clypeus, but a little less strongly so than in the two preceding species; front finely and closely punctured; clypeus transverse, somewhat convex, with large punctures; antennæ tolerably long, not thickened apically, scape elongate, about as long as the first joint of the flagellum, the latter joint scarcely one-third longer than the second; thorax shining, indistinctly punctured; mesosternum distinctly carinated, the epimerum and episternum mesothoracis separated; suture between dorsulum and scutellum foveolate; middle segment irregularly rugose posteriorly, the enclosure large, well defined, and covered with about 12 strong, somewhat wavy striæ; tibiæ and tarsi spinose; wings subhyaline, the marginal cell excepted, nervures brownish, stigma yellowish, submedian cell of posterior wings terminating much beyond the origin of the cubital vein; abdomen shining, almost impunctate, first segment not striated basally, pygidial area flat, rounded at apex, distinctly margined laterally, strongly punctured. Black; base of clypeus, scape beneath, sometimes a small spot on inner orbits beneath, pronotum, tubercles, a spot behind them, a stripe bordering the dorsulum laterally, scutellum, spot on metanotum, large spot on each side of middle segment, a fascia at apex of dorsal segments 1–5 and a narrow one at apex of ventrals 2 and 3 or 4, yellow; legs except base testaceous, the fore and medial femora more or less yellow beneath; basal half of flagellum beneath of the same color as legs, which color sometimes extends to the upper portion. Length 8 mm.

♂.—Colored like the ♀, but the clypeus entirely yellow and the flagellum entirely black; eyes strongly converging beneath, the space between them at the base of clypeus equal to somewhat more than half of that at the vertex; clypeus about twice as broad as long in the middle; flagellum long, somewhat setaceous, the joints more than twice as long as broad, the first two joints about equal in length; hind tarsi less thickened than in *asperatus*. Length 7–8 mm.

Montana. The color of legs, large spots of middle segment and

43. Gorytes angustus Prov.

Gorytes laticinctus Provancher (nec Shuckard), Add. Hym. Quebec, p. 274, ♂.
Gorytes angustus Provancher, Le Nat. Can., XXII, p. 141. ♀.

Vancouver (Provancher); Washington; California; Nevada. A variable species as to size and coloration. The abdomen in two (♀) specimens before me is densely tomentose so that when held in certain lights, its maculation is almost concealed.

44. Gorytes nevadensis Fox.

Gorytes nevadensis Fox, Can. Ent., XXIV, p. 150, ♀ ♂.

Nevada.

45. Gorytes venustus Cress.

Gorytes venustus Cresson, Proc. Ent. Soc. Phila., IV, p. 472, ♀ ♂.
Hoplisus venustus Cresson, Synopsis, p. 280.
Gorytes venustus Handlirsch, l. c., p. 504.

Colorado; Texas; New Mexico (Sante Fé, Cockerell); Mexico (Handlirsch).

46. Gorytes Smithii Cress.

Gorytes Smithii Cresson, Proc. Ent. Sect., A. N. S. Phila., 1880, p. 18, ♂ (non ♀) (Tr. Am. Ent. Soc., VIII).
Hoplisus Smithii, Cresson, Synopsis, p. 280.
Gorytes Smithii Handlirsch, l. c., p. 531.

Illinois; Kansas. The type of this species is a ♂, and not ♀ as stated by Cresson.

47. Gorytes floridanus Fox.

Hoplisus foveolata Fox (nec Handlirsch), Ent. News, I, p. 106, ♀.
Gorytes floridanus Fox, ibid., II., p. 196.

Florida. The eyes converge less toward the clypeus in this species than in *Smithii*.

48. Gorytes phaleratus Say.

Gorytes phaleratus Say, Bost. Journ. Nat. Hist., I, p. 367.
Gorytes fulvipennis Smith, Cat. Hym. B. M., IV, p. 367, ♀.
Gorytes apicalis Smith, ibid., p. 369, ♀.
Gorytes modestus Cresson, Proc. Ent. Soc. Phila., IV, p. 473, ♂.
Gorytes rufoluteus Packard, ibid., VI, p. 425, ♂ ♀.
Gorytes flavicornis Packard, ibid., p. 429, ♂ ♀.
Gorytes phaleratus Handlirsch, l. c., p. 507, ♀ ♂.

Occurs from Canada to Texas and Mexico; Colorado; Dakota. A variable species as the synonymy indicates.

49. Gorytes propinquus Cress.

Gorytes propinquus Cresson, Tr. Am. Ent. Soc., I, p. 379, ♂ (non ♀).
Gorytes abdominalis Handlirsch, l. c., p. 510.

New Mexico; Texas. Not identical with *abdominalis* as supposed by Handlirsch.

50. Gorytes abdominalis Cress.

Gorytes abdominalis Cresson, l. c., p. 474, ♂ ♀.
Hoplisus abdominalis Cresson, Synopsis, p. 279.
Gorytes abdominalis Handlirsch, l. c., p. 510.

Colorado.

51. Gorytes bipartitus Hdl.

Gorytes bipartitus, Handlirsch, l. c., p. 521.

Georgia.

52. Gorytes divisus Sm.

Gorytes divisus Smith, Catal. Hym. B. M. IV, p. 370, ♂.

Georgia (Smith). Unknown to me. This differs only from *bipartitus*, apparently, by the suture between dorsulum and scutellum being smooth, not foveolate. It is very likely, however, as suggested by Handlirsch, that Smith's statement is erroneous.

53. Gorytes rufomaculatus n. sp.

♀.—Eyes strongly converging toward the clypeus, somewhat less so than in *bipartitus*, however; front with large punctures, strongly impressed down the middle; clypeus convex, strongly punctured, about one-quarter broader than long, subemarginate in middle of anterior margin; antennæ shorter than in *bipartitus*, the flagellum subclavate; thorax smooth, impunctate; mesosternum distinctly carinated; suture between dorsulum and scutellum foveolate; enclosure of middle segment broad and short, well marked and divided by a longitudinal furrow; suture between metapleuræ and middle segment not foveolate; legs robust, tibiæ and tarsi spinose;

with joints not rounded-out as in that species, the last 6 or 7 joints not twice as long as broad; seventh dorsal segment distinct, broad, rounded at apex; hind tarsi somewhat thickened. Length 8 mm.

Dakota; Montana; Colorado (Gillette).

54. **Gorytes fasciatus** n. sp.

♂.—Eyes strongly converging toward the clypeus; the latter convex, distinctly broader than long; front strongly punctured, with a medial impressed line; antennæ much longer than in *rufomaculatus*, joints of flagellum cylindrical, rather long; thorax impunctate; mesosternum distinctly carinated; suture between dorsulum and scutellum foveolate; enclosure of middle segment well-marked; suture between metapleuræ and middle segment foveolate above only, and is deeper than in *rufomaculatus*; legs tolerably robust; wings yellowish on basal two-thirds; fuscous in marginal cell only, submedian cell of hind wings terminating much beyond the origin of cubital vein; abdomen long, dorsals 1 and 2 impunctate, the remainder strongly punctured, seventh dorsal distinct, rounded apically. Black; clypeus, inner orbits, face below antennæ, labrum, mandibles except apex, scape and pedicellum, line on pronotum, tubercles, spot behind them, scutellum posteriorly, spot on each side of middle segment, fore femora beneath, tibiæ and tarsi more or less, a broad fascia on dorsal abdominal segments 1–6, on ventrals 2 and 3 and spot on each side of ventrals 4–6, bright yellow; basal joints of flagellum, tegulæ and greater part of legs, reddish. Length 10 mm.

Colorado. Differs from the two preceding in the yellowish wings, yellow spots on middle segment, broad fascia of abdomen, and by the suture between metapleuræ and middle segment being foveolate above.

DECEMBER 3.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Forty-six persons present.

Trap Dykes in Chester County, Pennsylvania.—THEO. D. RAND stated that two important trap dykes in Chester County had seemed almost to have escaped notice. One of these, a peculiar porphyry, described by Mr. Goldsmith as containing the variety of silica, vestan, is best shown in Williams' quarry, near Aldham, on the Phœnixville branch of the Pennsylvania Railroad. It extends thence in a northeastwardly direction with a width of about 100 ft. It is not apparent to the westward, but a rock which Mr. Goldsmith has pronounced identical occurs near Barneston Station on the Waynesburg branch of the Pennsylvania Railroad. Some masses of this rock have a loud and clear ring when struck, as shown in specimens exhibited to the Academy by Mr. Borden.

The other dyke forms a bluff on the right bank of the Brandywine, almost in Downingtown, and perhaps 500 ft. north of the bridge which carries the Lancaster Turnpike over the creek. It is again exposed on the Pennsylvania Railroad just above the station, and again much more largely a quarter of a mile further west, where on the south side it is exposed for a depth of nearly thirty feet. Thence it may be traced by fragments up the South Valley hill for probin the Conshohocken dyke, but they had not yet been identified with this dyke.

This trap is quite coarse grained and is quite similar in its aspect throughout its whole extent, though coarsest to the northwest. It was examined by Mr. Goldsmith (specimens from the outcrop on Buck Run), who informed Mr. Rand that it is a gabbro-phonolite, containing as it does plagioclastic feldspar, sanidin augite, diallage, magnetite and hematite.

DECEMBER 10.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Forty-four persons present.

The death of Samuel G. Lewis, a member, was announced.

DECEMBER 17.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Thirty-one persons present.

Papers under the following titles were presented for publication:—

"Eclogæ Botanicæ, No. 2," by Edw. L. Greene.

"Notes on the Study of the Cross-Fertilization of Flowers by Insects," by Ida A. Keller, Ph.D.

The Committee on the Hayden Memorial Award reported as follows:—

REPORT OF THE COMMITTEE ON THE HAYDEN MEMORIAL AWARD.

The Committee on the award of the Hayden Memorial Medal and accompanying fund respectfully reports, that, at a meeting held on the 4th of December last, it was unanimously agreed to confer the award for the year 1895, upon PROF. KARL ALFRED VON ZITTEL of Munich, Germany, whose services to the sciences of geology and paleontology extend continuously over a period of thirty years.

In naming this candidate the Committee feels that it is honoring the sciences of which Prof. von Zittel is so distinguished an exponent, and only properly recognizes the researches which appeal to every student of geology.

Born in 1839, Prof. von Zittel was, at the age of twenty-four, appointed to the Professorship of Mineralogy at Karlsruhe, and three years later to the Professorship of Paleontology at the University of Munich, a position, jointly with that of Director of the Paleontological Museum, which he still holds. His published works cover a large range of personal investigation, not the least important of which are the researches into the structure and physiography of the Libyan Desert and the Sahara. His monumental work, "Handbuch der Paläontologie," which has only recently been completed, stands without rival in the literature of geology.

For this meritorious work the Committee respectfully recommend the award.

PERSIFOR FRAZER,
ANGELO HEILPRIN,
BENJ. SMITH LYMAN,
J. P. LESLEY,
THEO. D. RAND.
Committee.

DECEMBER 24.

The President, GENERAL ISAAC J. WISTAR, in the Chair.

Twenty-eight persons present.

DECEMBER 31.

CONTRIBUTIONS TO THE FLORA OF GREENLAND.

BY THEO. HOLM.

There is hardly any part of the arctic region that has been more thoroughly explored by botanists than the narrow strip of land which constitutes the west coast of Greenland, bordering on the inland ice.

Numerous expeditions, especially from Denmark and Sweden, have visited the country, and the literature upon this subject gives us a relatively complete knowledge of the distribution of a large number of plants in addition to notes on the general character of the vegetation. It is true, however, that the vegetation of several places, especially on the northern part of the coast, is still almost unknown to us. Explorations of late date have contributed to extend our knowledge of these more or less inaccessible localities, and the material collected is, therefore, of great importance. Interest attaches to two American expeditions to the northwestern coast, Cape York, Wostenholm Island, McCormick Bay, etc., localities which were either unknown or had so far only been slightly touched upon by botanists.

Mr. Wm. E. Meehan has reported[1] on the results of these expeditions, extending considerably the range of several plants. He has enumerated the various plants collected, and several rare species are recorded. A set of the duplicates was presented to the National Herbarium at Washington, and they have been studied by me with great interest, because of my own exploration of the coast of Greenland.

Some of Mr. Meehan's identifications are incorrect, and I therefore present the following notes in the hope of contributing to the accuracy of the results. The corrections are merely a supplement to Mr. Meehan's paper.

It is stated that *Dryas octopetala*, next to *Papaver*, is perhaps the commonest flower in Greenland. The plant sent to the National Herbarium represents *D. integrifolia* Vahl, not *D. octopetala*, of which, so far, but a very few specimens have been collected on the west coast by former expeditions.[1]

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[1] A Contribution to the Flora of Greenland. Proceed. Acad. of Nat. Sci. Philadelphia, April, 1893.

Other corrections are as follows:—

Ranunculus pygmæus Wahl. is *R. hyperboreus* Rottb.

Draba hirta L. from Disco is *D. arctica* Vahl.

Draba hirta L. from the Nunatak is *D. nivalis* Liljeb.

Cochlearia officinalis L. is *C. groenlandica* L.

Stellaria longipes Goldie is *S. humifusa* Rottb.

Potentilla pulchella B. Br. is *P. Vahliana* Lehm.

Saxifraga nivalis L. was mixed with *S. rivularis* L.

S. stellaris L. is the arctic variety *comosa* Poir.

Erigeron uniflorus L. is the variety *pulchellus* Fr.

Vaccinium uliginosum L. is the arctic variety *microphyllum* Lge.

Pyrola rotundifolia L. is *P. groenlandica* Horn.

Salix arctica R. Br. is *S. glauca* L.

Luzula arcuata Mey. is *L. confusa* Lindeb.

Eriophorum polystachyon L. var. *latifolium* is *E. angustifolium* Roth.

Carex atrata L. is *C. misandra* R. Br.

Poa nemoralis L. is *P. glauca* Vahl.

Poa pratensis L. is *P. flexuosa* Wahlbg.

Trisetum sesquiflorum Trin. is *T. subspicatum* Beauv.

Calamagrostis Langsdorffii is *C. phragmitoides* Hn.

only been found near Foulkefjord (78° 18′), so that the identification seems doubtful.

The same is the case with *Pedicularis versicolor* Wahl., which is not known from Greenland; it may have been confounded with *P. flammea* L., which is quite common.

Abies obovata Loud. is evidently a misprint.

Glyceria fluitans is also doubtful. It has never before been observed in Greenland, although there are several other species of *Glyceria* quite frequent in various places.

ECLOGÆ BOTANICÆ, NO. 2.

BY EDWARD L. GREENE.

1. Some New Western Plants.

Trifolium truncatum.

T. amplecteus Greene, Pitt. I, 6, not of Torr. and Gray.
T. stenophyllum Greene, Fl. Fr., 34, partly, not of Nutt.
T. Franciscanum var. *truncatum* Greene, Man., 100.

Annual, 5 to 10 inches high, branching from the base, slender, flaccid when young, the branches and peduncles wiry in age; herbage vivid green and glabrous: lowest leaflets broadly cuneiform and truncate, less than ½ inch long, the upper larger and ampler, 1 inch long, oblong-cuneiform or oblong-linear, truncate or obtuse, often retuse, not manifestly venulose, sparingly toothed: very slender peduncles exceeding the leaves: heads subglobose, about ½ inch in diameter when mature: corolla yellowish-white, tipped with dark purple, the tube at length inflated to the broadly obpyramidal and truncate, except as abruptly pointed by the withered remains of the tips of the petals.

This, one of the most common clovers of the middle California inland districts, I was long unable to believe to be an unrecognized

Trifolium lilacinum.

Annual, flaccid, the erect or merely decumbent branches 6 to 10 inches high: herbage apparently glabrous, but the growing parts more or less hirsutulous under a lens: lowest leaflets obovate, the upper oblong, or elliptic-lanceolate, minutely spinulose-serrulate: peduncles elongated, far surpassing the leaves and somewhat scapiform: hemispherical and amply involucrate heads ¾ inch broad; involucre of 8 or 10 obovate broad and somewhat overlapping laciniately cleft lobes; subulate-setaceous and plumose calyx-teeth about as long as the campanulate thin and scarious 5-nerved tube: corolla ½ inch long, of a rich deep lilac-purple tipped with pink or white.

A most beautiful ally of *T. barbigerum*, and of apparently quite limited range; but it is common on the lower slopes of one or two hills at South San Francisco, Cal., and has been collected once by Mr. Bioletti and once by myself on the eastern side of the bay still further southward.

Trifolium rostratum.

Annual, glabrous, very slender, diffuse, dwarf, the branches only 2 or 3 inches long: stipules rounded, spreading, laciniate: very slender petioles elongated; leaflets cuneate-obcordate, only ¼ inch long, evenly and acutely serrate-toothed: peduncles exceeding the leaves; involucre small but manifest, about 4 or 5 lines wide, lobed and laciniate: head less than ½ inch broad, rather few-flowered: calyx-teeth longer than the subcampanulate tube, oblong-ovate, tapering to a rigid aristiform apex: corolla purple, tipped with white, the keel with a long beak-like apex at least a third as long as the body.

A species of quite remarkable floral structure, collected only by Mr. V. K. Chestnut, at Lake Merritt, Oakland, California, 1889; at that time referred by me (Fl. Fr., 30), with much hesitation, to *T. appendiculatum*.

Boisduvalia diffusa.

Much branched from the base, the slender, wiry, white and shining sparingly leafy branches 8 to 12 inches long, very decumbent or almost prostrate, and, with the leaves, sparsely hirtellous when young, mostly glabrate in age: the scattered leaves, ovate and oblong-ovate, and ovate-lanceolate, ¼ to ¾ inch long, all sessile, and all, even the lowest as well as the uppermost, with a flower in the axil; petals about a line long, bifid, deep red-purple: capsule about 4 lines long, of oblong-lanceolate outline, curving outward, about 50-seeded: seeds dark brown, glabrous, somewhat angular, and of subclavate-oblong outline.

Dry bed of the upper Humboldt River, near Deeth, Nevada, Aug. 5, 1895.

Valerianella magna.

Glabrous, the stout stems sharply angular, 3 to 5 feet long, tortuous, half-reclining on fences or among bushes, and with rather many small axillary branches: cymes thyrsoidly congested at the ends of the stem and branches: corolla white, bilabiate, with ample funnelform tube and a short thick spur: fruit glabrous externally, triquetrous-ovoid, the ventral concavity formed by the ample wings closed below, open above, the wings themselves strongly hispid-ciliate within.

Collected only by the author, in Knight's Valley, Sonoma Co., Cal., June, 1894. Species noteworthy on account of its great size and half-climbing habit; the fruit showing an affinity with *V. aphanoptera*.

Valerianella ciliosa.

Slender, erect, simple, seldom a foot high, corolla small, deep pink, very distinctly bilabiate, the rather slender and tapering spur much longer than the body and produced far below the ovary: fruit of roundish outline but modified by a very prominent stout apiculagently spinescent-tipped: involucral bracts narrow, acute, glandular-puberulent: corollas yellow.

Species known only from Monterey, California, where it has been collected in recent times by Parry, Pringle, Tidestrom and others, but earlier, as shown in the herbarium at Kew, by Hartweg. In the American herbaria it is found mixed sometimes with *L. germanorum*, sometimes with *L. glandulifera*..

Pyrrocoma eriopoda.

Caudex ligneous, covered with a dense white wool connected with the bases of the petioles of the oblong lanceolate obtuse coarsely toothed coriaceous glabrous or minutely scabrous leaves; stem erect, rigid, 1 to 2 feet high, with a few ascending or suberect branches; cauline leaves spatulate, the rameal ovate, acute, remotely serrate, less than 1 inch long: heads solitary on the ends of the branches and in the axils of the leaves; involucres turbinate-campanulate, about ½ inch high; bracts very rigid, oblong linear, green throughout, but more herbaceous at the erect pungently acute apex: rays 15 to 20, not showy.

Collected at the Soda Springs, Esmeralda County, Nevada, July, 1888, by Mr. Shockley.

Pyrrocoma solidaginea.

Stems rather stout, decumbent, 12 to 18 inches high, lanuginous-tomentose throughout, but the leaves, and often all but the base of the stem glabrate at maturity: radical leaves lanceolate, on rather slender petioles, 2 to 5 inches long, entire or irregularly serrate, abruptly acute; cauline spatulate, sessile by an auriculate-clasping base: stem parted at the middle or toward the base into numerous slender suberect branches bearing numerous racemosely disposed, small heads: involucres campanulate, ¼ inch high; bracts imbricated loosely in about 3 series, linear, or oblong-linear, the green-herbaceous erect tips pungently acute: rays 12 to 18, small, light yellow.

Along the Humboldt River, at Palisade, Nevada, 24th of July, 1893. Species much resembling a *Solidago;* the small heads not rarely numbering as many as seventy-five on a single stem.

Pyrrocoma subviscosa.

Stems not rigid, 14 to 20 inches high, only slightly decumbent: leaves, upper part of stem, and the inflorescence glandular-puberulent and resinous-viscid: leaves not in the least degree coriaceous; radical 6 or 8 inches long, lanceolate or linear-lanceolate, very acute, saliently and sharply serrate-toothed; the sessile cauline ones more strongly toothed and the teeth spreading: heads only 3 to 5, corymbose at summit of the stem: involucres broadly hemispherical, ½ to ¾ inch broad; bracts linear-lanceolate, acute, in about 3 not very unequal series, herbaceous almost throughout except the innermost: rays 30 or more, showy.

Near the Humboldt Wells, in eastern Nevada, 25th of July, 1893. To be compared only with *P. lanceolata*, from which it differs most notably in the membranaceous texture of the whole plant as well as in the fine close glandular indument.

Aster militaris.

Rigidly erect, 1 to 1½ feet high, equably leafy and simple up to the somewhat fastigiately corymbose panicle: leaves 2 or 3 inches long, scabrous-puberulent on both faces, and with scabrous-ciliolate margins, midvein prominent, lateral nerves none, the upper cauline lanceolate, very acute, mucronate by the excurrent strong midvein, tapering to a narrow half-clasping base, entire or obscurely serrate-toothed: involucre turbinate, the oblong-linear obtuse bracts numerous and much imbricated, green-herbaceous along the midvein and at tip, pubescent, appressed; rays numerous, pale-purplish: achenes sparsely pubescent: pappus not copious, rather fragile.

A well-marked species of genuine *Aster*, but not intimately related spreading, bristly-ciliate, otherwise glabrous: rays large, rose-red or purple: achenes sparsely strigose; pappus firm.

In wet subalpine meadows, toward the limit of trees on Mt. Reinier, Washington; collected by the writer, 21st of August, 1889; probably not rare in the higher Cascades, and possibly forming a part of the confused *A. foliaceus* var. *frondeus of* Gray's *Synoptical Flora*, but very distinct from the type of that variety, which belongs to a different region.

Aster frondeus.

Aster foliaceus, var. *frondeus* Gray, Syn. Fl., I, Part 2, p. 193, in part only.

Stems stoutish, decumbent, 1 to 2 feet high, green and nearly glabrous, mostly simple up to the summit and bearing a solitary head, or two or more on very short peduncles: leaves not thin, glabrous except the scabrous-ciliolate margins, entire; radical obovate-oblong, petiolate; cauline spatulate; acutish, 2 to 4 inches long, auriculate-clasping: heads rather more than ½ inch high, twice as broad: bracts of involucre of about equal length, the outer ovoid or oblong and amply foliaceous; inner more spatulate, but herbaceous almost throughout: rays ½ inch long, light blue or purplish.

Plant of the Rocky Mountain region in Colorado and Utah, thence northwestward to the borders of California and perhaps Oregon; inhabiting middle altitudes; its habit much like that of *Solidago Parryi* (*Aplopappus Parryi* Gray), but heads few or solitary.

Vagnera pallescens.

Rather slender, horizontally inclining (not erect), 2 or 3 feet high, the whole plant of a pale glaucous-green, but not glabrous: leaves sessile, ample, ovate-elliptic, obtusish, or with abrupt short apiculation, thin and widely spreading, 4 to 6 inches long, nearly glabrous above, rather stiffly hirtellous beneath: panicle of racemes rather open, 4 to 6 inches long: flowers white, very fragrant: berries deep cherry-red.

Species inhabiting higher than middle elevations of the California Sierra, from at least Fresno Co., northward: very unlike the stout erect upright-leaved bright green *V. amplexicaulis* of lower altitudes, and of more northerly range, to which it has been referred.

2. Revision of Tropidocarpum.

To the knowledge of this very noteworthy genus of plants, as it was published by Sir William Hooker almost sixty years since, nothing new was contributed until within the last decade. It was, indeed, as recently as the year 1888 that, in a peculiar district of the Californian territory, I discovered a very clear, new species, presenting fruit characters so precisely conformed to those of some capparids, that I at once published the species as *T. capparideum;* and still more recently a third species has been detected by Dr. A. Davidson, in southern California, and published by him under the uncomplimentary name of *T. dubium.*

On my return from Europe a year ago, having seen and carefully examined not only Hooker's type specimens, but also other valuable and instructive materials at Kew, I was ready to give, and had hoped to have written before this, what is still much needed, a critical revision of the species.

This generic type is altogether Californian, none of the species ranging eastward beyond the western foothills of the Sierra Nevada, or extending northward beyond the valley of the upper Sacramento; though to the southward one has been found as far beyond the State boundary as San Quentin on the peninsula of Lower California.

From almost all known cruciferous plants, and from all other American cruciferæ, these differ notably, and very constantly, in their leafy, or at least leafy-bracted inflorescence; a character which they have in common with all capparids; and, if the remarkable *T. capparideum,* with its ample bladdery and wholly partitionless pod, dehiscing from the apex rather than from the base,

T. gracile Hook., Ic., t. 48; Torr. and Gray, Fl., I, 94; Greene, Fl. Fr., 278, and Man., 27.

Pod 1 to 1½ inches long, lance-linear to linear, strongly obcompressed throughout, the cross-section nearly or quite linear; partition extremely narrow, but apparently never wanting; seeds in one row, filling each narrow keel-like valve, in outline somewhat quadrately oblong, black.

T. macrocarpum Hook. and Harv. in Herb. Kew. "? *T. dubium*" Robinson, in Gray, Syn. Fl., I, 141, ex descr., but not as to Davidson's type. *T. gracile*, var. *scabriusculum*, Greene, Fl. Fr., 278, and Man., 27, partly, but not *T. scabriusculum* Hook.

Pod 1½ to 3 inches long, narrowly linear (often little more than ½ line wide), very flatly obcompressed throughout, or occasionally the lower ¼ or ⅓ as flatly compressed laterally, this part destitute of partition, but the upper division obviously partitioned: ripe seeds unknown.

T. dubium Davidson, Eryth., II, 180.

Pod ½ to 1½ inches long, lance-linear, 1 line wide, the cross-section distinctly and rather sharply rhombic, either 1-celled throughout, or the upper ⅓ or ¼ obcompressed and partitioned: seeds half as large as in *T. gracile*, dark brown, obovoid.

T. capparideum Greene, Pitt., I, 217; Fl. Fr., 278; Man., 27; probably "? *T. capparideum*," Robinson, l. c.

Pod oblong, or linear-oblong, about ¾ inch long, slightly obcompressed, the cross-section elliptic-oblong, partition wholly wanting; valves 4, but two narrower than the others and more persistent: seeds in 4 rows.

The first of the above species is the most variable one, being usually erect and simple, with little pubescence, the pods without any. In a more freely branching state, with abundant rather harsh pubescence, it is *T. scabriusculum* Hook., though not what I formerly so considered; and I find the transition from typical *T. gracile* to this so numerous, and the distinction so slight, that I should hardly concede to the latter even varietal rank.

The second species, *T. macrocarpum*, hitherto unpublished, is what I had mistaken for *T. scabriusculum*; and it was at Kew that I discovered my error, where I found this very distinct species indicated as a new one, in the handwriting of Harvey, with the above name assigned it. Dr. Davidson, of Los Angeles, included it in his *T. dubium*, but it is very different from the type of that species in its pod.

The third species, Dr. Davidson's *T. dubium*, as to the typical plant, is an excellent one by the sharply rhombic cross-section of the short pod. In the only specimen of his which I have access to, there is no instance of that twist in the pod which he assigns to the species; whence I infer that he has included in it, the preceding; but the essential character of that is its extremely long and narrow very flat pod.

The fourth species, *T. capparideum*, is such a remarkable connecting link between two or three distinct natural orders, that herbarium botanists of the old school would naturally sit more at ease if such a plant had not been discovered. It has invariably a 4-valved pod and 4 placentæ. The valves separate from the placentæ beginning at the top, just as in the capparids; and when all four of the valves have fallen away, the four placentæ, joined together at the summit, remain in place, quite as in certain genera of Papaveraceæ. The pods are constantly devoid of every trace of a partition, and there is not the least suggestion of anything anomalous about the plant. In its locality it is even more abundant than any other species, and less disposed to vary than is the typical species of the genus. The statement in the *Synoptical Flora*, p. 141, as to the capsules, "commonly containing a small capsule-like structure at base," it is based on a single instance. Dr. Robinson's imagination would seem to have led him to guess that this malformation may be

NOTES ON THE STUDY OF THE CROSS-FERTILIZATION OF FLOWERS BY INSECTS.

BY IDA A. KELLER.

One of the most remarkable discoveries in plant physiology was certainly that of the cross-fertilization of plants by the aid of insect visitors. That this discovery, made toward the end of the last century, was founded upon actual fact has been verified by almost every one who has become interested in this most remarkable phenomenon. Apparent as it is in many cases, in more instances, cross-fertilization by means of insects is simply a conjecture. There is no more fruitful source of error, perhaps, in the experience of all scientific knowledge than a sudden brilliant discovery, which is founded upon careful observations in a limited number of cases, and the wholesale application of its results without the exercise of sufficient caution. Again and again, the organic world has been shown to be so complex that no one simple formula can be found to express adequately the exact situation in each of a great variety of cases. Experience is constantly showing that each particular case must be carefully studied by itself before we can with any degree of certainty gain a thorough understanding of any general phenomenon in plant or animal life.

In my attempts to obtain an impartial view of the subject of cross-fertilization, so far as the actual observations made in this field up to the present day will permit, I was struck with a number of curious facts in connection with the development of our knowledge in this direction. I must, however, apologize for the rather meagre presentation of the subject. I have had neither the time nor the opportunity to acquaint myself thoroughly with its entire literature, and the original observations which I have made in this line are limited in number.

Conrad Sprengel, as we all know, discovered "The Secret of Nature Revealed in the Formation and Fertilization of Flowers." Over one hundred years have passed since this was recorded, and yet the plant world offers in this respect one puzzle after another.

Instead of having exhausted the study of the subject by this time, it seems to be gaining in interest.

Naturally enough, it was not the tendency of scientists to try to disprove what was evidently true from the observations of Sprengel, but rather to develop more fully our knowledge of cross-fertilization. I need only refer to the famous work of Darwin, to that of the well-known German botanists, Hildebrand, H. Müller, Kerner, and to that of the many close observers of our own day.

The fact that cross-fertilization is of utmost value to the individual species has been emphasized by Darwin. In fact, this great discoverer contends repeatedly that pollen applied to the pistil of the same flower is a positive injury to the species. It is curious to note how this idea has influenced the authors of botanical text-books. As one instance in many, I need only refer to Gray's *Structural Botany*. To the rather long chapter devoted to the description of the adaptation of flowers to insure intercrossing, a few paragraphs are added in which the writer, it seems to me rather unwillingly, admits that there are also special adaptations to insure close fertilization, in fact, that there are cases which positively exclude all chances of a cross. Of cleistogamous flowers, Gray says: "Here the intention and the accomplishment of self-fertilization are unmistakable. This peculiar dimorphism consists in the production of very small or inconspicuous and closed flowers, necessarily self-fertilized and fully fertile in addition to ordinary, conspicuous, and much less fertile, though perfect flowers."[1] He then continues: "It no species is altogether cleistogamous, taken as a premise, the following conclusion is drawn: "Thus, cleistogamy, with all its special advantage, testifies to the value of intercrossing." The same bias, looking favorably upon cross-fertilization, may be observed in most writers on the subject. The prevailing impression seems to be that close fertilization is, as a rule, only resorted to when all the chances for cross-fertilization are at an end.

It appears that the problem permits of a wholly different solution. Among the few writers who admit this, there is perhaps none who speaks with as much decision and who adduces as many facts to prove his assertions as does Mr. Meehan. In his interesting paper, entitled "Are Insects any Material Aid to Plants in Fertilization"—the conclusions are as follows:—

First: The great bulk of colored flowering plants are self-fertilizers.

Secondly: Only to a limited extent do insects aid fertilization.

Thirdly: Self-fertilizers are every way as healthy and vigorous, and immensely more productive than those dependent on insect aid.

Fourthly: That where plants are so dependent, they are the worse fitted to engage in the struggle for life, the great underlying principle in natural selection.

These views are directly opposed to the impression one would naturally receive from text-books on botany. It is evident that it is of the utmost importance to study the significance and, if possible, the cause of each of the various factors with which we have to deal as pointing either towards cross- or towards close-fertilization. As already suggested, it is always a critical matter to generalize where thousands of species are concerned which have developed under a variety of circumstances.

Let us now consider the chief adaptations which point towards cross-fertilization:—

I. Distinct sexes.
II. Specially adapted or conspicuous corolla.
III. Peculiar position of stamens and pistils.
IV. Difference in the time of maturity of stamens and pistils.

I. *Distinct sexes.* The male and female flowers being separated it is a matter of necessity that the pollen of one flower finds its way to the stigma of another flower. From a teleological point of view the intention is clearly shown. We cannot, however, speak with certainty of cross-fertilization even in all these cases, except in wholly diœcious plants, at least not in Darwin's understanding of the term, which is, that "cross-fertilization always means a cross between distinct plants raised from seeds." We must, therefore, be careful not to include too hastily in this category monœcious plants, where the male and female organs are borne on distinct flowers but on the *same plant*.

II. *A specially adapted or conspicuous corolla.* It is these showy, irregular or peculiarly shaped corollas that insects may readily be observed to visit. The questions which here arise are numerous. The first one to present itself is this: Has the corolla been developed for the purpose of attracting insects, and is it the proof which nature gives us that cross-fertilization is a necessity or that it is at least favorable to the preservation of the species? This seems to have been definitely answered in the affirmative. The number of cases where the insect has actually been seen to transport the pollen from one plant to another, however, are few, compared with the great number of species whose flowers would come under this head. In this connection it must be remembered how very often the insect is simply a robber. This past summer I observed, *e. g.*, a very large patch of *Gerardia pedicularia*, the flowers almost all being pierced at the base of the corolla by bees perching on the outside and never touching stamens or pistil. Now, wherever it is more convenient for the insect to reach the desired substance without boring a hole it is apt to be taken for a benefactor, even if it simply takes from the

"Bees alight sometimes on the corolla, touching styles and stamens, crushing them all up together with the styles, and probably causing self- as much as cross-fertilization."[3] This in spite of the fact that the flower of this plant is to all appearance well adapted to secure cross-fertilization. I should not be surprised if, sooner or later, upon close examination, it would be found that in many cases where this adaptation to insects seems so perfect, the insect visitors aid in securing self-fertilization, as these observations seem to indicate.

III. *Peculiar position of stamens and pistils.* In the preceding paragraph I have already briefly referred to the flowers of *Kalmia latifolia*, perhaps the best illustration of such an arrangement. The wheel-shaped corolla, with the ten pockets in which the anthers are held, is sufficiently familiar to require no further description. Stamens and pistil mature at the same time. The anthers are held in the pockets of the corolla; when visited by insects they are set free and the pollen is thrown with considerable force from the anther sacs through the orifices. As I have remarked before I have observed repeatedly that pollen was thrown upon the stigma of the same flower. Careful observations should decide the question, how far in such cases, where there is such a peculiar arrangement in the position of stamens and pistils in regard to each other, close fertilization is possible.

Even should it be impossible in any case that autogamy, or close fertilization, is effected, it must be remembered that whenever a plant bears many, or clusters of flowers, the chances of cross-fertilization are reduced. Insects in such cases may visit many flowers of the same plant, but this is not cross-fertilization in Darwin's sense of the term.

IV. *Dichogamy or difference in the time of maturity of stamens and pistils.* This appears to me the most suggestive and interesting phase of this intricate problem. From a teleological point of view, *i. e.*, if we look for a purpose, we must agree with Darwin and his followers that this is one of the most remarkable adaptations favoring cross-fertilization. Modern science insists, however, that we must use inductive methods, and it is the tendency of the present day to search rather for the causes than for an underlying purpose. If, on the one hand, we affirm that every organ is modified to serve some particular use, we cannot believe, on the other hand, that such modifications are directly due to external factors over which the plant has no control. I am aware that the principle of natural selection may find its application in the most subtle cases; at the same time it requires, in this particular instance, a considerable strain to make it fit. In reference to dichogamy Mr. Meehan says positively that the difference between the time of maturity of stamen and pistil is caused by varying degrees of temperature and that dichogamy has its origin in this circumstance, "that whatever its significance, it arises from no effort innate to the plant itself, but from an outside force that can have but little interest in cross-fertilization."[4] It is peculiarly characteristic of the present day to seek for the effect of external conditions and to experiment with the modifications that can be brought about by changing these. For example, Prof. Goebel says in reference to cleistogamic flowers, "We do not yet know the conditions necessary for the production of cleistogamic flowers, but it may be assumed even now that this production is influenced by external factors wherever a plant has the power to produce such flowers."[5] He then cites experiments made with *Impatiens fulva*, where cleistogamic flowers are the result of poor nutrition. Accordingly, it appears at least possible that experiments might give similar results in reference to dichogamy.

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[3] Ibid., p. 57.

Attention has often been called to the fact that in plants especially adapted to insure cross-fertilization, there exists in almost every case a possibility of self-fertilization. The above statements in regard to dichogamy, if of any value, point to a different con-localities and at different times of the year as possible, since there is no doubt there are great variations possible in the fertilization of flowers in the same species caused by different conditions of heat, moisture, etc.

If autogamy should in any case prove the rule we must regard fertilization by aid of an insect as an exception, not to call it an accident. Dichogamy probably is then in a measure due to external conditions. If this is true it is simply the result of a "lagging behind" in the ripening time of either stamens or pistils, and the final autogamy is the result of a subsequent "catching-up" in this respect. This is, as I have said before, probably the most interesting side of the question, and the one which will no doubt prove the most satisfactory for experimental investigation.

In conclusion I desire to make the following suggestions:—

First:—It is evident that the study of the phenomenon of cross-fertilization of flowers by means of insects is still a profitable field for observation and discovery.

Second:—The effect of external conditions in reference to dichogamy should be the subject of critical experiments.

Third:—Teleological explanations should be avoided as much as possible, here as elsewhere, according to the spirit of modern investigation.

Finally:—The relative number of cases of cross- and close-fertilization should be compared, and it should be determined if cross-fertilization actually takes place in all cases where this is assumed.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The meetings of the Academy have been held during the year without any intermission, a quorum being always present even during the midsummer months. The average attendance has been thirty-three. The verbal communications have been of interest and have frequently been followed by animated discussion. The speakers have been Messrs. Goldsmith, Rand, Woolman, Ryder, Ives, Woodbury, Boyer, Holman, Rex, Morsell, Morris, Dixon, Leonard, Daland, Abbott, Allen, Pilsbry, Parvin, Ball, Hopkins, Vaux, Calvert, Oberholtzer, Horn, McCook, Keely, Skinner, Foote, Miller, Lyman, Willcox, Cope, Mercer, Heilprin, Smock, Sommerville, Brinton, Schumo and Miss Walter. Several of the most important of these communications have been reported by their authors for publication in the *Proceedings*.

Since the last report 608 pages of the *Proceedings*, illustrated by eighteen plates, have been issued, together with 114 pages and seven plates of the *Journal*, constituting Vol. IX, Part 4. The text of the memoir by the late Andrew J. Parker on the Primate brain has been printed and will be issued as the third part of Vol. X as soon as the plates can be prepared.

Harris 1, J. B. Ellis 1, J. B. Ellis and B. M. Everhart 1, William Kennedy 1, D. D. Baldwin 1, Henry Sutor and H. M. Gwatkin 1, Arnold E. Ortmann 1, Emma Walter 1, Charles Morris 1, W. B. Scott 1, Ida A. Keller 1, Thomas Meehan 1, D. W. Coquillet 1, J. Percy Moore 1, Warren M. Foote 1, Edwin Chapin Starks 1, Gerard Fowke 1, Edw. J. Nolan 1, T. D. A. Cockerell 1, Theo. Holm 1. Thirty-four of these have been printed in the *Proceedings*, two others have been accepted for publication, and the remaining three, those by Mr. Moore, will form a portion of Part 4, Vol. X of the *Journal.*

Twenty-three members and three correspondents have been elected. The deaths of fourteen members and of twelve correspondents have been announced; the resignations of four members, Messrs. R. W. Ryerss, B. Alex. Randall, Mayland Cuthbert and H. N. Rittenhouse, have been accepted, and ten names have been stricken from the roll in consequence of non-payment of dues. It will thus be seen that the elections have not been sufficient to counterbalance the losses and that the number of members on the roll is less than at the close of the year 1894. In another and more important respect the past year has not been a prosperous one for the Academy, because of the loss of five of its most active members at short intervals. Reference is made to the deaths of J. B. Brinton, M.D., Geo. A. Rex, M.D., John H. Redfield, W. S. W. Ruschenberger, M.D. and John A. Ryder. The benefits conferred by these in their several ways on the society have been recorded by grateful resolutions and memoirs in the pages of the *Proceedings.*

The most important administrative event of the year was the signing, June 18th, of the revised articles of agreement between the Academy and the American Entomological Society, by which it is hoped harmonious coöperation in scientific work has been permanently secured.

The formation of an Anthropological Section was duly authorized April 30th, and the work accomplished during the ensuing months has proven the desirability of such a bond of union among those interested in that department of science.

Mr. Henry A. Pilsbry was elected to the Professorship in the Department of Mollusca; and Prof. Heilprin having resigned the Chair of Invertebrate Paleontology was immediately appointed by the Council to that of Geology.

The deaths of the active members before alluded to, left several vacancies in the Council and Committees. Dr. Brinton was succeeded in the Council by Mr. Chas. P. Perot; Dr. Rex by the Hon. John Cadwalader; Mr. Redfield by Dr. Harrison Allen, while Mr. Henry A. Pilsbry was elected to succeed Dr. Ruschenberger as Curator.

The Committee on the Hayden Memorial Award has this year reported in favor of conferring the medal and balance of the interest of the fund on Prof. Karl Alfred von Zittel of Munich, in recognition of his distinguished services to paleontological science.

The lecture room and hall of the Academy have, as heretofore, been used for meetings and lectures by several scientific societies, including the Geographical Club, the Botanical Club, the Delaware Valley Ornithological Club, the Mineralogists' Club, Wood's Holl Biological Association and the Odontographic Society.

All of which is respectfully submitted.

Edw. J. Nolan,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

The Corresponding Secretary respectfully reports that during the library and eighty-four of gifts to the museum have been forwarded.

Respectfully submitted,

Benj. Sharp,

Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The past year has been a most prosperous one for the library of the Academy. The entire additions amount to 10,389. Of these 6,032 are volumes, 4,111 pamphlets and parts of periodicals, and 10 maps, photographs, etc.

Nearly one-half of these accessions form the James Aitken Meigs Library, bequeathed to the Academy, together with an important pecuniary legacy, by John G. Meigs, the father of Dr. J. A. Meigs. There are many works in the collection which duplicate those already in the library of the Academy. These have not yet been separated from the other volumes. The total of accessions also includes 217 duplicates and miscellaneous works received from Mr. Meehan, in addition to 182 volumes included in the statement given below.

The current growth of the library, excluding the Meigs' bequest and the duplicates above alluded to, depended on the following sources of supply: —

Societies,	2,462
I. V. Williamson Fund,	1,090
Editors,	930
Authors,	187
Thomas Meehan,	176
Charles P. Perot,	32
U. S. Dept. of Agriculture,	29
U. S. Dept. of the Interior,	28
Wilson Fund,	18
U. S. Dept. of State,	12
General Appropriation,	12
Geological Survey of Russia,	11
Tennessee State Board of Health,	11
Ministry of Public Works, France,	10
U. S. Treasury Dep.,	5
Geological Survey of New Jersey,	5
Geological Survey of Canada,	5
Geological and Nat. Hist. Survey of Minnesota,	4
U. S. War Dept.,	4
Geological Survey of India,	4
Geological Survey of Alabama,	3
William J. Fox,	3
U. S. Commissioners of Fish and Fisheries,	3
Illinois State Board of Agriculture,	3
Smithsonian Institution,	3

Bureau of Ethnology, U. S. Dept. Interior,	3
Bentham Trustees, Kew Gardens,	3
H. A. Pilsbry.	3
California State Mining Bureau,	2
Philip P. Calvert,	2
Iowa Agricultural College,	2
Iowa Geological Survey,	2
British Government,	2
Dept. of Mines, New South Wales,	2
Norwegische Commission der Europäischen Gradmessung,	2
Comision Geológica de Mexico,	2
British Museum,	2
U. S. Coast and Geodetic Survey,	1
U. S. Dept. of Labor,	1
Massachusetts Commissioners of Inland Fisheries,	1
Dept. of Mines, Nova Scotia,	1
J. G. Whiteman,	1
Guatemalan Government,	1
Illinois State Bureau of Labor,	1
C. W. Ruschenberger,	1
Natural History Survey of Illinois,	1
Indian Museum Trustees,	1
H. T. Broadhurst,	1
J. Percy Moore,	1
B. B. Valentine,	1
Kentucky Inspector of Mines,	1
Manchester Museum,	1

The additions to the library thus credited were assigned to the several departments as follows:—

Journals,	4,059
Botany,	203
Geology,	114
General Natural History,	86
Entomology,	58
Voyages and Travels,	43
Anthropology,	18
Physical Science,	18
Mineralogy,	14
Encyclopedias,	13
Helminthology,	12
Ichthyology,	10

Physical Science,	70	Entomology,	7
Geology,	40	Mammalogy,	6
Botany,	32	Mineralogy,	4
Useful Arts,	28	Conchology,	2
Chemistry,	18	Miscellaneous,	18
Bibliography,	8		
			5,089

It will thus be seen that an important section of the library is not strictly in place in the Academy, and, as has been already stated, when carefully arranged and catalogued, a large number of duplicates will doubtless be found. The gift, notwithstanding, is the most important the library has received, exclusively, since the I. V. Williamson Library Fund came into the possession of the Academy, and a brief account of the legacy, as a matter of permanent record, may not be out of place.

MR. JOHN G. MEIGS was born in Philadelphia in 1801. He was engaged during his active life in the manufacture and sale of shoes, his place of business being on the west side of Fifth Street above Chestnut. He was so well regarded by his friends and customers, because of his honorable dealing, as to have acquired the enviable name of "Honest John Meigs." By strict attention to his work and judicious investments in real estate, he laid the foundation of a fortune which enabled him later to retire from the cares of business life. While not himself a man of college education, he was fully aware of the desirability of intellectual training. His son, James Aitken Meigs, was therefore encouraged to take advantage of the public school system of education, culminating in the Boy's Central High School, from which he graduated in 1848. He then matriculated in Jefferson Medical College, from which he obtained his diploma as Doctor of Medicine in 1851. He was elected a member of the Academy the following year, and was immediately placed under those influences which were so important in determining his future distinguished career. He served as Librarian from August, 1856, until May, 1859, when he was compelled to resign the office in consequence of the increase of his professional engagements.

After his retirement from business, Mr. Meigs and the Doctor were much more intimately associated than is usually the case even with father and son. The mother having died July 28th, 1870, at the age of sixty years, the two men kept house together, during the latter years of their lives at No. 1408 Spruce Street, where they accumulated the library which is now in the possession of the Academy. Notwithstanding the old gentleman's lack of literary and scientific training, there was a sufficient community of tastes between the two to establish a close fellowship, the son's pursuits being encouraged and his successes gloried in by the father. The premature and unexpected death of Dr. Meigs occurred November 9th, 1879, in his fiftieth year.

Appreciative biographical notices of Dr. Meigs have been published by Dr. H. C. Chapman in the Transactions of the College of Physicians of Philadelphia, 3d Ser., Vol. V, and by Dr. George Hamilton in the Transactions of the Medical Society of the State of Pennsylvania for 1880, so that it is not necessary to dwell further on the incidents of his career. The character of the library, as indicated by the classification here given, is sufficient evidence of the extraordinary catholicity of his tastes.

After the sad bereavement, his father, with a natural desire to remain surrounded by objects to which were attached such tender associations, declined to part with either books or instruments. The latter were carefully packed away, and the library remained just as the son had left it, until the death of Mr. Meigs.

Early in 1893 your Librarian was informed that a zealous but indiscreet member of another society had assured Mr. Meigs that the Academy not only did not desire possession of the library but, on account of its miscellaneous character, would decline to receive it were it offered. A statement of the utterly erroneous nature of appropriate sections of the main library, if the gift were made to the Academy, but that before considering farther the propriety of making such gift or bequest he must be assured that none of the volumes would be parted with by sale or otherwise, but that, apart from the conceded arrangement of the scientific works, the rest of the collection should be kept together permanently as the James Aitken Meigs Library. This condition was accepted on behalf of the Academy by your Librarian in the presence of Mr. Meigs' friend, Dr. R. K. Hinton, and his housekeeper, Miss Lizzie Rogers.

A few days later the will was made, leaving to the Academy the books, scientific instruments and the sum of $20,000, one-half of which is for the exclusive benefit of the library. The other half is left without restriction or condition and has not yet been specifically appropriated by the Council. Mr. Meigs died May 10th, 1895, and the library was shortly after removed to the Academy. It is confidently believed that the legacy depended on the agreement made with Mr. Meigs regarding the custodianship of the library. It is therefore held to be incumbent on the Academy to act in conformity with this understanding, although the wording of the will grants a greater degree of liberty.

The scientific portions of the James Aitken Meigs Library have been placed, as far as the present supply of case-room will permit, with the appropriate sections of the general library, the volumes being appropriately labelled; while the works on literature, philosophy, history, religion, etc., have been arranged temporarily in the Council room. The duplicates will ultimately be placed in the main library, when the Academy will, of course, be at liberty to dispose of the works replaced by them.

The late John H. Redfield, as a farther evidence of his long-continued interest in the botanical department of the Academy, directed by will the sale of his scientific library and collections, the receipts to be invested for the benefit of the Botanical Section. The books have been disposed of at auction. The duplicates included in the Meehan gift were sold at the same time by direction of Mr. Meehan, the sum realized to be applied to the same object: the increase of that which, by resolution of the Botanical Section, is to be known as the John H. Redfield Fund.

Through the foresight of the Corresponding Secretary a new section, which cannot fail to be of importance to the Department of Instruction, has been added to the library during the year. It consists of a collection of lantern slides, for the purpose of lecture illustration. Those now in the possession of the Academy have been derived from the following sources: John G. Meigs' bequest 135, Prof. Alfred Bickmore 100, Dr. Benjamin Sharp 45, Prof. E. D. Cope 26, Dr. H. Skinner 16, and Prof. D. G. Elliot 4. The collection has been classified and catalogued by Dr. Sharp and is now ready for use.

Acknowledgment is again due Mr. Wm. J. Fox for the faithful and intelligent discharge of his duties as assistant to the Librarian during the past year.

All of which is respectfully submitted.

EDWARD J. NOLAN,
Librarian.

REPORT OF THE CURATORS.

The Curators report that the various collections in their charge are in a still more satisfactory state of preservation than at the time of their last annual report, while great progress has been made during the year in the rearrangement and cataloguing of the several departments and many valuable additions have been received.

Although the first floor of the new museum building is practihas been engaged to classify and label the Mexican archæological specimens, and has already completed a portion of the work. Much additional archæological material has been transferred during the year to the new building, three additional cases and six large tables being provided for its reception.

A boiler has been erected in the engine-house and the heating plant of the new building is thus rendered practically complete.

The west end of the main floor of the old museum has been separated by a partition of glass and woodwork, thus forming a commodious apartment which will soon be occupied by the Entomological Section. New radiators have been provided for heating the same, while radiators have also been placed in the rooms formerly occupied by the Wm. S. Vaux Collections, east of the library gallery.

Early in the year the entire collection of bird skins was removed from the cramped quarters in the library and cellar and placed in the southeast room, formerly devoted to the Wm. S. Vaux Collections, which now forms an excellent study room for those engaged in ornithological investigation, while the adjoining room has been used as a general work room for the taxidermist and others engaged in the preparation of specimens. The northeast room on the same floor has been devoted to the use of the artists and transient workers. The basement of the new building has also been fitted up for the use of the taxidermist, and all the larger work has been done there. The transfer of the west end of the main floor of the old museum to the Entomological Section has necessitated considerable rearrangement of cases, and the removal of the osteological collections to the second floor of the new building, while the mammal and fossil cases are necessarily much crowded. This condition is, however, only temporary, and as soon as cases can be provided the entire series of mammals will be transferred to the new building, leaving ample room for the display of the palæontological collections.

Rev. Dr. L. T. Chamberlain has generously provided a second fine case for the Lea Collection of Eocene Fossils, and has employed Prof. G. D. Harris during the year to make a careful study of the original Lea type collection, with the result that the whole is now entirely rearranged on specially printed labels, and all the type specimens carefully designated.

Mr. C. W. Johnson has been engaged, also by the Rev. Dr. Chamberlain, on another expedition to the Eocene formation in

Louisiana and Texas in the interest of the Lea Collection, and has brought back a valuable series of additions. Dr. Chamberlain has also had a handsome wainscoting erected in the vestibule of the new building, above which are to be placed the slabs of fossil foot-prints presented by the late Dr. Isaac Lea.

Apart from the preparation and arrangement of the accessions, the work in the museum during the year has been mainly confined to the arranging and cataloguing of the departments of Ethnology, Ornithology and Mineralogy.

In the first department, the entire collection of human crania has been consistently numbered and carefully checked off in the printed catalogue of the Morton Collection, a large amount of uncatalogued material systematically entered, and the whole copied into the new catalogue and brought up to date.

In the ornithological collection, over 4,000 specimens have been worked over on the plans previously outlined, and many additional specimens mounted. All the types have been unmounted and placed in air-tight cases. For this purpose, one large additional tin case has been provided, and twenty large packing cases have been procured for the temporary storage of duplicate specimens of large water birds. Fuller particulars in this department are furnished in the report of the Ornithological Section.

In cataloguing the minerals great progress has been made, nearly 4,000 specimens have been entered in the catalogue, and a large portion of the remainder arranged for cataloguing.

One of the most important accessions of the year is a series of specimens obtained by Dr. Benj. Sharp during a summer expedition on board the U. S. Revenue Cutter "Bear." These collections, however, have just been received, and have not yet been studied or prepared for presentation.

Dr. S. G. Dixon and Mr. H. C. Mercer obtained, during the year, additional collections of fossil remains from the Port Kennedy limestone cave. These have been properly prepared, presented and added to the valuable series obtained last year.

During May and June, Mr. S. N. Rhoads made a journey through the State of Tennessee in the interest of the Academy, and obtained valuable collections of the reptiles, birds, mammals and mollusks of this interesting region, all of which have been placed in the museum, and reported upon in the *Proceedings* of the Academy.

Other valuable accessions during the year have been a collection of Pennsylvania and New Jersey birds, received from Samuel N. Rhoads, with other small collections of birds from T. H. Montgomery, Jr. and A. Sydney Logan.

The Delaware Valley Ornithology Club has continued to add liberally to its interesting collection of local birds. Under the efficient management of Mr. Jefferis, the Wm. S. Vaux Collections have been largely increased and kept in most satisfactory condition.

The botanical collection, during the past year, has been under the care of Messrs. Thos. Meehan and Stewardson Brown, while the Entomological Department has continued under Dr. Skinner's supervision. To all these gentlemen, the Curators desire to express thanks for their valuable assistance, and also to Messrs. Schulze, Boyer, Woolman and Keely, who have devoted much time to the cataloguing and arrangement of the microscopical collections.

The Curators would also acknowledge the efficient work of their assistants, Messrs. Witmer Stone and Samuel N. Rhoads, to whose earnestness and fidelity the successful progress of the museum work is largely due; and they also express their appreciation of the work of the taxidermist, Mr. D. N. McCadden, and the valuable assistance of the students of the Jessup Fund, Miss Helen M. Higgins, Messrs. Henry W. Fowler, H. C. Borden, Wm. J. Gerhard and E. G. Vanatta.

The interest of the general public in the museum is shown by the large attendance of visitors during the year, while specialists in various departments have frequently consulted the collections. Specimens have been loaned to Messrs. R. Latchford, F. W. Stokes, O. F. Cook, H. C. Mercer, Professors B. W. Evermann, Chas. E. Bessey, W. B. Cook and R. Ridgway.

HENRY C. CHAPMAN,
Chairman of the Curators.

REPORT OF THE MICROSCOPICAL AND BIOLOGICAL SECTION.

The meetings of the Section during the past year have been regularly held, the attendance averaging slightly more than the previous year. The best communications of the Section have been always reserved for the meetings with the Academy, and consequently our minute-book is not a record of all the work done. Thus, during February last Dr. C. L. Leonard exhibited, under the auspices of the Section, thirty lantern slides showing cell motion. Dr. Dixon, Prof. Ryder, Mr. Woolman, Mr. Holman, Mr. Schumo, Mr. Keely and the Recorder have made communications before the general meeting in connection with the work of the Section. Before the Section itself, Messrs. Woolman, Keely, Parvin, Brown, Schulze, Holman and Schumo made communications of special interest. The Section suffered severely in the deaths of two esteemed members, Dr. George

Mr. F. J. Keely, the Conservator of the Section, reports as follows:—

The instruments of the Section are in a serviceable condition, new spring clips on two of the smaller stands having been the only repairs required. In addition to their use at the separate meetings of the Section, at least four of the stands have been regularly on the table at the joint meetings with the Academy, on which occasions interesting slides have generally been provided by members, or when this was not the case, the collection of the Section was drawn upon. The collection of slides is in fairly presentable condition, those that required it having received an extra ring of cement. During the year the following additions have been made:—

An arrangement for cutting sections of minute objects, devised by Mr. Ryder, presented by Mr. Trenner.

One Welsbach Light, one Maltwood Finder. Purchased.

One Beck Binocular Microscope, one Zentmayer Monocular Microscope, one Histological Microscope, one Dissecting Microscope, one Class Microscope, together with a large number of accessories, including twelve objectives and 200 slides, formerly the property of J. Aitken Meigs, M. D., bequeathed by his father, John G. Meigs.

One dozen mounts of selected diatoms, and one dozen strewn slides of diatoms, presented by J. A. Schulze.

Seven slides of nerves, presented by M. V. Ball.

The following officers have been elected for the ensuing year:—

Director, ... Benjamin Sharp, M. D.
Vice-Director, ... John C. Wilson.
Treasurer, ... Chas. P. Perot.
Conservator, ... F. J. Keely.
Corresponding Secretary, . . John G. Rothermel.
Recorder, ... M. V. Ball, M. D.

M. V. BALL,
Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

During the year 1895 specimens have been added to the collection of mollusks from 115 persons, the accessions including a large proportion of species new to the collection and a considerable number of type specimens.

Accessions of special value have been received from Mr. D. D. Baldwin, who gave the types of many new species of *Achatinella;* from W. T. Bednall, who has continued to send us rare and new South Australian Chitons; from C. F. Newcombe, a large series of marine shells dredged near Victoria, B. C.; and from the late Robert Walton, whose collection was presented entire. Other valuable material has been received from Prof. H. E. Sargent, O. A. Nylander, O. A. Crandall, G. H. Clapp C. W. Johnson, Wm. J. Fox and others. Messrs. Ford, Roberts and Van Nostrand have continued to enrich our series with various new and rare species as in former years.

The Conservator has obtained in exchange for duplicate material a considerable number of species new to our collection, including a fine series of Transylvanian shells from E. A. Bielz, with specimens of many of Bielz's own species; a series of Tonquin land shells from M. Ph. Dautzenberg; a large number of North African Helices from M. O. Debeaux, including many species described by him; also a full series of Mr. C. J. Maynard's species of *Strophia.*

With the assistance of Mr. E. G. Vanatta, who has recently been appointed on the Jessup Fund, the Conservator has made good progress toward labelling and cataloguing specimens which have accumulated during the past few years; and, with the same efficient help, it is believed that all arrears of work on material of this nature will be completed during the winter.

The Conservator has been chiefly occupied in the preparation of the several numbers of the Manual of Conchology; but no small amount of time has been consumed in the work of identifying specimens for conchologists and in correspondence on conchological subjects. It is believed, however, that the large amount of new and interesting material secured by this means repays for the labor and time involved.

H. A. Pilsbry,
Conservator.

REPORT OF THE ENTOMOLOGICAL SECTION.

The usual monthly meetings of the Section have been held and were well attended by its members and associates. Numerous verbal communications of great interest entomologically have been made by nearly all the members. The collections are in a good state of preservation considering the faulty cases in which some orders are kept. These will gradually be replaced by safe dust- and pest-proof receptacles. The library is growing rapidly, and during the year four hundred and ninety-five entries have been made in the donation book. A large number of insects have also been presented. The present quarters devoted to the Section are entirely inadequate, and it hopes soon to be able to occupy the new room set apart for it by the Academy. Two members and two associates have been elected. The journal of the Section, *Entomological News*, has been successfully continued and three hundred and forty pages and fifteen plates published during the year just closed. It will be continued in the new year, and an illustrated edition of six hundred copies of thirty-two pages per month will be printed. At the annual election held

December 9th the following were elected officers to serve during the coming year:—

Director,	George H. Horn, M.D.
Vice-Director,	Charles S. Welles,
Recorder,	Henry Skinner, M.D.
Treasurer,	Ezra T. Cresson.
Secretary,	William J. Fox.
Conservator,	Henry Skinner, M.D.
Publication Committee,	Charles W. Johnson, James H. Ridings.

HENRY SKINNER,
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Botanical Section respectfully reports that the general progress noted in former annual reports still continues, notwithstanding the severe loss sustained by the death last April of its most zealous and untiring member, John H. Redfield, who had been the able Conservator of the Academy's Herbarium since the formation of the Section. His death renders the recommendation of former years, that a permanent Conservator should be employed, still more pressing. It is believed that a fund of $20,000 would yield enough to make a fair start in this direction. Mr. Redfield perceived this necessity, and generously willed that his scientific books and collecexcept during the three summer months, and matters of wide botanical interest have been regularly discussed. Mr. Stewardson Brown has been serving very efficiently as Conservator pending the annual election. His report showing the condition of the Herbarium, is herewith appended.

The officers elected for the ensuing year are as follows:—

Director,	Thomas Meehan.
Vice-Director,	Charles E. Smith.
Recorder,	Charles Schäffer, M.D.
Treasurer,	Stewardson Brown.
Corresponding Secretary,	Joseph D. Crawford.
Conservator,	Stewardson Brown.

THOMAS MEEHAN,
Director.

The Conservator of the Botanical Section reports as follows:—

In presenting this report for the year your Conservator wishes to congratulate the Section on the general good condition of the Herbarium at the present time.

The permanent mounting of the specimens in the general Herbarium, commenced some years ago, has been carried steadily forward during the present year, largely through the untiring efforts of the Director of the Section, Mr. Thomas Meehan; and we can now report the work done as far as Umbelliferæ.

The additions received during the year have been 1,683 species, of which 332 are lower Cryptogams, and 1,351 Phanerogams and Ferns; of the latter, 442 species are from North America, 426 from tropical America, 253 from Asia, and 226 from Australia and Polynesia.

Notable among these are the following collections:—

245 species of Newfoundland plants received from the Howard Herbarium, Cambridge; 111 species of Northern California plants received from Prof. E. L. Greene; 425 species of Mexican plants collected in 1894, by Prof. C. G. Pringle, and purchased through the liberality of some of the members of the Section; 253 species of Asia Minor plants collected by Prof. Bornmuller, and purchased for the Section, and 126 species from the Azores Islands, collected in 1893 by Mr. C. S. Brown, and purchased for the Section.

Of these collections, some 350 species are new to the Herbarium.

It will be seen from the foregoing that a large proportion of the additions during the past year have been acquired through purchase, entailing a considerable expenditure on the part of a few of the members, owing to the lack of funds available for such purposes. While such outlay will undoubtedly be necessary to some extent in the future, yet it is hoped that by a proper system of exchanging, which we expect to effect shortly, much additional material can be acquired. The Section now has in hand a considerable quantity of material which can be readily used for this purpose as soon as adequate space is furnished for its arrangement, which time we hope is not far distant.

The attention of the Section was called to the crowded condition of the present cases, in the report of the Conservator for 1894, and it is hoped before the report for 1896 is made this much-needed room for expansion will have been provided; and the present cases fitted with doors of the best dust-proof construction.

Respectfully submitted,

STEWARDSON BROWN,
Conservator, pro tem.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL

in fact a considerable number have been promised as soon as case-room is provided.

At the meeting of the Section, held December 23d, the following officers were elected for the ensuing year:—

Director,	Theodore D. Rand.
Vice-Director,	Wm. W. Jefferis.
Conservator,	Wm. W. Jefferis.
Treasurer,	John Ford.
Corresponding Secretary and Recorder,	Chas. Schäffer.

Respectfully submitted,
Theo. D. Rand,
Director.

REPORT OF THE ORNITHOLOGICAL SECTION.

The work of cataloguing and rearranging the Ornithological collection has gone on steadily during the past year; and, although not quite so many specimens have been worked over as in the previous year, this has been more than compensated by the large increase in the labelling and cataloguing.

The Conservator has been enabled to devote a considerable amount of his time to the work, as has also Mr. McCadden, the taxidermist, while valuable assistance has been rendered by Mr. Henry W. Fowler, Miss Helen M. Higgins and Mr. Wm. J. Gerhard.

During the year 4,193 mounted specimens have been worked over, the best of them being remounted and the types and duplicates reduced to skins, and all the material not hitherto named has been carefully identified and catalogued. In addition to this a large number of temporary lists were copied into the regular catalogue, which has now been brought up to date, while a considerable number of labels for specimens in the exhibition cases have been prepared. This work for the year aggregates 4,125 labels written, and 9,979 entries in the catalogue. The groups renovated in the mounted collection comprised the Cathartidæ, Falconidæ, Bubonidæ, Strigidæ. Fringillidæ, Ploceidæ, Laniidæ, Motacillidæ, Alaudidæ, Artamidæ, and Dicæidæ, while specimens were remounted for exhibition in the Muscicapidæ, Oriolidæ, Dicruridæ, and Campophagidæ.

The accessions during the year have amounted to 1,020 specimens, the most important being a collection of birds from Pennsylvania and New Jersey, presented by S. N. Rhoads, a small collection of Pennsylvania birds from Dr. Thos. H. Montgomery, a small collection from Tennessee made during May and June by Mr. S. N. Rhoads, and a well-mounted collection of game birds from Mr. A. Sydney Logan. A fine pair of Flamingoes has been purchased for mounting, and a number of valuable specimens from the Zoological Society of Philadelphia have been prepared, either as mounted specimens, skins or skeletons.

The southeast room on the gallery floor of the library was placed at the disposal of the Section early in the year, and the entire collection of skins removed to it, where they are much more accessible to the student; while the enlarged quarters furnish increased facilities for work in this department. One large tin case for the preservation of type specimens has been provided during the year, as well as twenty wooden packing cases for the temporary storage of duplicate specimens of large water birds and birds of prey.

The entire collection of skins has been examined during the year and found to be in excellent condition.

The Delaware Valley Ornithological Club has rendered valuable aid to the Section in arousing a lively interest in ornithology in this

Director, ...	Dr. Spencer Trotter.
Vice-Director, ...	George S. Morris.
Recorder, ...	Stewardson Brown.
Secretary, ...	William A. Shryock.
Treasurer and Conservator, ...	Witmer Stone.

Respectfully submitted,
WITMER STONE,
Conservator.

REPORT OF THE ANTHROPOLOGICAL SECTION:

The Anthropological Section of the Academy, the formation of which was authorized by votes of the Academy on April 23d and 30th, 1895, was organized on the evening of April 30th, Dr. Harrison Allen being chosen as Chairman, Charles Morris as Secretary and Treasurer. It has held meetings in May, October, November and December, and has received special communications from Mr. John Ford on Indian grave mounds, from Drs. Mills, Ball and others on brain and skull degeneration, and from Dr. Sharp on the Ethnology of Alaska and Siberia. Twenty-eight members have joined the Section. A meeting for organization was held in December, at which the following officers were elected:—

Director, ...	Harrison Allen, M.D.
Vice-Director, ...	Dr. C. N. Peirce.
Recorder, ...	Charles Morris.
Secretary and Conservator, ...	M. V. Ball.

CHARLES MORRIS,
Recorder.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALEONTOLOGY.

The Professor of Invertebrate Paleontology respectfully reports that the condition of the collections that were under his charge until December 1st—when his duties became associated with the Department of Geology—remains much as it was at the time of the filing of the last annual report. As for a number years past, the one great obstacle to arrangement and classification in the deficiency of exhibition-room and cases; indeed, at the present time, there is even less room than heretofore, owing to the necessary division of the main hall into a section devoted to entomological interests. Only with occupancy of the new hall can proper relief be expected.

The usual spring course of lectures has followed as a continuation of the courses of past years, and it is gratifying to be able to report that the attendance has been steadily increasing year by year, the enrolled students for the past season numbering 116. Emphasis is again laid on that portion of the instruction which is associated with field-work, when an opportunity is given to examine practically much of that which is first illustrated in the class-room. In addition to the regular Saturday field-parties, the course included, for a limited number, an examination in the month of August of the Rocky Mountain region, when the practicability of so extended a class-excursion was clearly demonstrated. The region studied comprised sections of Colorado, Wyoming, Utah and New Mexico, and specifically the Pike's Peak district, gold mines of Cripple Creek, "bad lands," Great Salt Lake, cañons of the Price, Grand and Arkansas Rivers, the volcanic masses of the San Juan, etc.

As Professor of Geology, the undersigned would respectfully recommend, the disposition of the geological materials of the Academy, space in the new hall, and that enough of it be given for that form of display which is now a part of the method of almost every new museum. A geological exhibition means not merely a

REPORT OF THE PROFESSOR OF ETHNOLOGY AND ARCHÆOLOGY.

The Professor of Ethnology and Archæology reports that during the current year a regular course of lectures on his branch was delivered in the Lecture Hall of the Academy. The audience was large, and a growing interest was manifested in the subject.

The collections in this department are in process of installation in the new building and a portion of them is satisfactorily displayed. With proper facilities all the objects illustrating this important branch of natural history in possession of the Academy, can now be grouped together and opened for inspection.

D. G. Brinton, M.D.,
Professor of Ethnology.

REPORT OF THE PROFESSOR OF INVERTEBRATE ZOOLOGY.

The Professor of Invertebrate Zoology respectfully reports that during the past year he has delivered two lectures, one upon "Corals and the Coral Islands," and one upon "Zoological Gardens."

The additions to the museum during the year have been neither numerous nor important.

The course of lectures planned and mentioned in the report of last year was not delivered owing to preparation for and departure upon an expedition to Bering Sea, the Arctic Ocean and adjacent shores.

Permission was obtained from the Treasury Department of the United States to accompany the U. S. Revenue Cutter "Bear" during her cruise in the Arctic Ocean. The Aleutian and Seal Islands and the northern shores of Siberia and Alaska were visited. Collections were made at all points where it was possible. Collections of plants, birds, marine forms and native implements were among the most important made. The skin of a walrus and the skins of a male, female and young fur seal were obtained. For permission to secure the skins of the fur seals the Academy is indebted to the special favor of the U. S. Treasury Department.

As the collections were not received until after the close of the fiscal year, a report upon them must be deferred.

A course of six lectures on the "Influence of the Environment upon Animal Life" will be delivered in January and February, 1896, and during the spring two lectures in addition will be given upon the results of the Alaskan and Siberian expedition.

Respecfully submitted,
BENJ. SHARP,
Prof. of Invert. Zoology.

REPORT OF THE PROFESSOR OF HISTOLOGY AND MICROSCOPIC TECHNOLOGY.

The Professor of Histology and Microscopic Technology respectfully reports that he has given laboratory instruction in microscopic technic and carried on, as heretofore, original research in bacteriology.

The gifts of instruments and slides will be reported by the Biological Section.

SAMUEL G. DIXON,
Prof. of Histology and Microscopic Technology.

REPORT OF THE PROFESSOR OF MALACOLOGY.

The Professor of Malacology reports that there have been added to the museum several thousand species of mollusks; among others, the types of many new forms of Polyplacophora and Achatinellidæ,

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTIONS.

The Curator of the William S. Vaux Collections reports that the mineralogical cabinet is in good order. There are a number of specimens which, too large to be placed in the present cases, are exposed to the dust and liable to be injured. A special case should be provided for them. Since his appointment as Curator he has added 618 specimens to the collection, bringing the number up to 7,780.

The archæological collection is also in good condition, but no additions have been made to it during the past year.

Wm. W. Jefferis,
Curator.

The election of Officers, Councillors and Members of the Finance Committee to serve during 1896, was held with the following result:—

President, ...	Samuel G. Dixon, M.D.
Vice-Presidents, . . .	Thomas Meehan.
	Rev. Henry C. McCook, D.D.
Recording Secretary, . .	Edward J. Nolan, M.D.
Corresponding Secretary, .	Benjamin Sharp, M.D.
Treasurer, ...	George Vaux, Jr.
Librarian, ...	Edward J. Nolan, M.D.
Curators, ...	Henry A. Pilsbry.
	Henry C. Chapman, M.D.
	Arthur Erwin Brown.
	Samuel G. Dixon, M.D.
Councillors to serve three years,	Uselma C. Smith.
	William Sellers.
	Charles E. Smith.
	John Cadwalader.
Finance Committee, . .	Charles Morris.
	Chas. E. Smith.
	Uselma C. Smith.
	William Sellers.
	Charles P. Perot.
Council, to serve for an unexpired term . . .	Isaac J. Wistar.

October 29.—John M. Justice, Howard W. Du Bois, Charles C. Harrison.

November 26.—Gulielma M. S. P. Jones, Wilfred H. Harned, Seneca Egbert, M.D., Samuel H. Gilbert, W. W. Frazier, John Cadwalader, Jr.

CORRESPONDENTS.

February 26.—P. B. Sarasin, of Basel; D. Estanislao S. Zeballos, of the Argentine Republic.

April 30.—Rudolph Virchow, of Berlin.

ADDITIONS TO THE MUSEUM.

1895.

ARCHÆOLOGY, ETHNOLOGY, ETC.

Dr. M. V. Ball. Five human brains (criminal).

Frank Chew. Collection of Indian axes and arrowheads, Maryland.

John G. Meigs' Bequest. Nine human crania, including five Etruscan skulls from Corneto, Italy.

C. B. Moore. Large collection of aboriginal mound relics, including implements, pottery, ornaments and human crania and skeletons from central Florida. Two pre-Columbian crania of Huron-Iroquois Indians, Ontario.

H. E. Sargent. One tray sherds pottery, Tennessee River, Ala.

Dr. Benjamin Sharp and Prof. Libbey. Ten Kanaka skulls, Sandwich Islands.

MAMMALS.

Thomas Biddle. Articulated skeleton of *Hylobates mülleri*, Sarawak, Borneo.

Dr. S G. Dixon. Ear-bone of seal, Islesboro, Me.

J. Edward Farnum. Mounted *Cephalophus natalensis*, E. Africa.

Herman Haupt, Jr. Skulls of *Arctomys* and *Scalops*, Minnesota and Illinois.

rufimanus, *Cynocephalus anubis* and *Atherura africana*. Skeletons of *Macacus ochreatus*, *Paradoxurus* (sp.?), *Capromys* (sp. ?), *Mazama temama*, *Kobus defassus* (2), *Bison bison*, *Capreolus capreolus*, *Cervus porcinus*, *Camelus bactrianus*, *Melursus labiatus*, *Vulpes velox* and *Erethizon dorsatus*. Skins of *Paradoxurus* (sp.?), *Dasyprocta* (sp.?), *Lemur* (sp.?), *Macropus* (sp.?), *Capromys* (sp.?), *Dasyprocta acouchy*, *Mazama temama* (2), *Kobus defassus* (2), *Bison bison* (juv.) and *Vulpes velox*. Skulls of *Dasyprocta fuliginosa*, *Hapale aurita*, *Tamandua tetradactyla*, *Dasyprocta cristata*, *D. variegata*, *Mazama temama* and *Cynocephalus anubis*.

BIRDS.

W. L. Baily. One Acadian owl skin, Pennsylvania.

A. L. Buckwalter. One parrot.

Mrs. M. J. Chase. Nine mounted specimens and two skins, California. One hundred and eighteen skins, mostly *Trochilidæ*.

Delaware Valley Ornithological Club. Forty-one mounted birds and seven nests and sets of eggs.

Dr. S. G. Dixon. Mounted *Meleagris gallopavo*, Virginia.

Miss Irma F. Hering. One mounted *Olor columbianus*.

In exchange. One skin of *Nyctea nyctea*, Greenland.

A. Sydney Logan. Forty-eight mounted specimens of game birds.

T. H. Montgomery, Jr. Seventy-six skins, Pennsylvania and Maine.

George S. Morris. Eighteen skins.

Purchased. Twenty-six skins, California. Two skins *Phœnicopterus ruber*, two skins *Ardea cærulea*.

S. N. Rhoads. Six hundred and eighty skins of Pennsylvania and New Jersey birds. Three skins *Dendragapus franklini*.

Tennessee Expedition; collected by S. N. Rhoads. Fifty-eight bird skins.

Zoological Society of Philadelphia. Mounted specimen of *Psophia viridis*. Skins of *Psophia viridis*, *Zenaida castanea*, *Dominicella rubra*, and *Psittacus erithacus*. Skeletons of *Struthio camelus*, *Argusianus argus* (2), *Buteo vulgaris*.

REPTILES AND BATRACHIANS.

James Bradley. One *Dermochelys coriacea*, Asbury Park, N. J.

I. N. DeHaven. One *Amblystoma punctatum*, Ardmore, Pa.

J. Hope. One *Naia bungara*.

H. A. Pilsbry. Fifteen reptiles and batrachians, Florida.

S. N. Rhoads (Exp. to Tennessee). Two hundred and sixty-six specimens Reptilia and Batrachia, Kentucky and Tennessee. Fifteen reptiles, Florida. Seventy-nine specimens, Somerset Co., N. J.

Witmer Stone. Four turtles, Chester Co., Pa.

Dr. R. R. Taylor. One rattlesnake, W. Virginia.

———. One *Menopoma alleghenienis.*

Zoological Society of Philadelphia. Alcoholic specimens of *Sternotherus derbianus*, *Uromastix hardwickii*, *Python molurus*, *Naia bungara* (2), *Varanus niloticus*, *Trachycephalus marmoratus* and *Hyla arborea.*

FISHES.

Wm. E. Meehan. Thirteen deformed *Salmo fontinalis*, U. S. Fish Commission, Allentown, Pa.

Dr. T. D. Myers. Two *Hybopsis biguttatus*, Monocacy River, Md.

Messrs. Pilsbry and Johnson. *Achirus lineatus*, Lake George, Fla.

———. *Lophius piscatorius*, lower Delaware River.

CRUSTACEA.

Geo. H. Clapp. Three specimens of *Cambarus virilis*, Canada.

John Thompson. One *Limulus polyphemus*, Cape May, N. J.

INSECTS.

C. W. Johnson. One case of *Diptera*, Pennsylvania and New Jersey.

Miss A. H. Miller. Hornet's nest, Lawrenceville, Va.

S. N. Rhoads. Three *Cychrus*, one *Chalcophorus*, New Jersey and Tennessee.

Dr. H. Skinner. One case of *Lepidoptera*, Pennsylvania and New Jersey. Three *Lepidoptera.*

Miss J. D. Winsor. Three Beetles.

LOWER INVERTEBRATES.

A. W. Anthony. Five species (alcoholic).

D. D. Baldwin. Large collection of *Achatinellidæ*, with types of thirty-five new species and eleven species in alcohol.

E. A. Barber. *Helicodonta obvoluta*, England (alcoholic).

Mrs. Beaman. Nine species West Mexican marine shells.

W. T. Bednall. Twenty-nine species (marine), South Australia.

E. A. Bielz (in exchange). One hundred and sixty-two species, Transylvania.

F. E. Blanes. Cuban *Helices* in alcohol.

H. Clay Borden. *Physa*, Pa.; *Helix aspera*, banana bunch (alcoholic).

Chas. S. Boyer. *Ostræa*, Japan.

B. Buckingham. Two species, Bermuda.

J. H. Campbell. Specimens of *Acanthochites*.

Mrs. G. W. Carpenter. Forty-three species of marine shells.

J. E. Chilberg. *Polygyra townsendiana*, living.

Geo. H. Clapp. Nine species, living *Vitrina limpida*.

Conchological Section. One hundred and twenty-eight species (purchased)

M. Cossmann (in exchange). Fourteen species of land and fresh-water shells.

P. Z. Cox (in exchange). Two species *Zaila*, E. Africa.

O. A. Crandall. Twenty-two trays of *Physa*; Texan land shells.

Jas. Crawford. Sixteen species, South Africa.

W. H. Dall. Twenty-two species.

Ph. Dautzenberg (in exchange). Thirty species of land shells, Tonquin.

Rev. A. Dean. Four species, African ; three American.

O. Debeaux. Fifty species of North African land shells, in exchange.

W. H. De Camp. Two species of fresh-water shells.

J. M. Delaney. Specimens of *Bulla ovulum*.

Dr. S. G. Dixon. Four species, Maine.

Dr. C. S. Dolley. Five species of land mollusks, Italy.

Mrs. H. E. Dwight. Five species marine shells.

John Ford. Forty-two species.

W. J. Fox. Twenty-three species, West Virginia, and other specimens.

Mrs. E. M. Gaylord. Specimens of *Chama pellucida*.

Dr. W. D. Hartman. *Melania corporosa*.

Chas. Hedley. Specimens of land shells, Australia.

J. B. Henderson. Nineteen species of Jamaica land shells in alcohol.

A. A. Hinkley. Ten species, *Strepomatidæ*.

Geo. A. Hubbard. *Strobilops* from Minnesota.

Dr. W. E. Hughes. *Polygyra dentifera*, Canada.

F. W. Hutton. Specimens of *Chiton sinclairi*.

J. E. Ives. Three species.

W. W. Jefferis. *Campeloma* and *Unio*, Ft. Edward, N. Y.

C. W. Johnson. Twenty-six species.

I. A. Lapham. Specimens of *Pomatiopsis cincinnatiensis*.

F. R. Latchford. Collection of Canadian mollusks.

Roberts Le Boutillier. *Ostræa virginiana*, near Boston.

Geo. Lichtenthaler. *Lucapina* and *Lucapinella* in alcohol.

Geo. T. Marston. Four species of fresh-water shells, Wisconsin.

C. J. Maynard (in exchange). Sixty-six trays of *Cerion*.

D. N. McCadden and Dr. W. E. Hughes. Seven species of Virginian land shells.

J. D. Mitchell. *Unio mitchelli*, *Macoma tampaensis* and *Tellina mitchelli*.

Wm. Moss. A new *Flammulina* from New Zealand, and other shells.

Miss K. Musson. One species of *Helix*.

C. F. Newcombe. Eighty species of marine shells dredged near Victoria, B. C.

Dr. E. J. Nolan. *Helix pomatia* and *H. arbustorum*, Bavaria.

A. H. Norton. Three species.

O. A. Nylander. Collection of shells from northern Maine.

H. A. Pilsbry. Collection of Planorbes, mainly from Western and Southern States; several species of land and marine mollusks.

John Ponsonby (in exchange). Thirty-seven species of land shells from Haiti and South Africa.

L'Abbé Provancher. Eight Canadian species.

S. N. Rhoads. Mollusks from Washington and Pennsylvania.

John Richie, Jr. Four trays of shells.

S. R. Roberts. Several species of land shells.

E. W. Roper. Types of *Patella kermadecensis;* several land mollusks.

F. A. Sampson. *Pomatiopsis intermedia*, California, and four species land shells (alcoholic).

U. S. Department Agriculture. *Amnicola*, *Tryonia*, *Bythinella*, and *Fluminicola* from Nevada and "Death Valley."

E. G. Vanatta. Ten species of shells.

H. D. Van Nostrand. Three species of *Cerion;* eleven species of marine shells, Japan.

Bryant Walker. Several Michigan mollusks.

Robert Walton. Four hundred and fifty species.

R. B. Watson. Collection of Madeira mollusks in alcohol.

G. W. Webster. *Strobilops*, Florida

A. G. Wetherby. Land mollusks, Tennessee and North Carolina.

Chas. Le Roy Wheeler. Several mollusks from Cape May.

Geo. Williamson (in exchange). Collection of Louisiana mollusks.

Willard M. Wood. *Zonites*, San Francisco, Cal.

L. Woolman. Two species, fresh-water mollusks, New Jersey.

Purchased by subscription. *Nautilus pompilius* L., in alcohol.

PLANTS.

Mrs. Bartol. *Bryophyllum calycinum* and *Bougainvillea glabra*, cultivated, Florida.

Geo. M. Beringer. Twenty-nine species of *Eucalyptus*, cultivated in California.

Walter Deane. *Lemna valdiviana*, Randolph, Mass.

Dr. Geo. E. Davenport. *Aspidium simulatum* and *Aspidium cristatum* x *marginale*, Massachusetts.

J. B. Ellis. Century Thirty-three, North American Fungi.

Dr. E. L. Greene. One hundred and eleven species, northern California plants.

Dr. H. A. Greene (through Geo. M. Beringer). Thirty-three species North American Marine Algæ.

Wm. Hacker. Forty-eight species North American plants.

Herbarium of Harvard University. Two hundred and forty-five species of New Foundland plants collected by B. L. Robinson and H. Schrenk.

Roberts Le Boutillier. Fruit of *Entada scandens* from Jamaica.

Thomas Meehan. Ravenel's Fungi Caroliniani Exsiccati, Fascicles IV and V. Sixty-five species of North American plants. Two hundred and fifty-three species of Asia Minor plants collected by Bornmüller; four hundred and twenty-five Mexican plants collected by C. G. Pringle; one hundred and twenty-six species of Azores Island plants collected by C. S. Brown.

Mrs. Potts. Two hundred and fifty-three species of plants collected in Asia Minor by Bornmüller.

John H. Redfield. Seven species of North American plants.

Dr. Chas. Schäffer. Two hundred and fifty-three species of Asia Minor plants collected by Bornmüller.

Uselma C. Smith. Seeds of *Entada scandens* from Jamaica and one hundred species of plants from Jamaica.

Charles E. Smith. Two hundred and fifty-three species of Asia Minor plants.

Baron Ferdinand Von Müller (through Thomas Meehan). Eleven species of Australian plants.

MINERALS AND ROCKS.

H. C. Borden. Seven specimens of Pyrite, French Creek, Pa.

L. T. Chamberlain. One Calcite, Alabama River, Ala.

A. H. Fisher. Two trays, Obsidian and Lazurite.

Dr. E. Goldsmith. One Dolomite with Quartz, Belvidere, N. J.

E. A. Groth. One Garnet, Fairmount Park, Pa.

H. Haupt, Jr. Fifteen specimens, United States and Russia.

H. G. Ives. One Limonite, Chester Co., Pa.

Mineralogical and Geological Section. Muscovite, Chester Co., Pa.

Theo. D. Rand. One each, Talc and Uranophane, Pennsylvania and Georgia.

Lieut. Ruschenberger, U. S. N. Native Copper, Coquimbo, Chili.

Jas. F. Sullivan. Petrified wood, 2 spec., Gibbsboro, N. J.

Students Mineralogical Club. Twenty-four specimens, Pennsylvania.

William S. Vaux Fund. One hundred and eighty-two specimens for Wm. S. Vaux collection of minerals.

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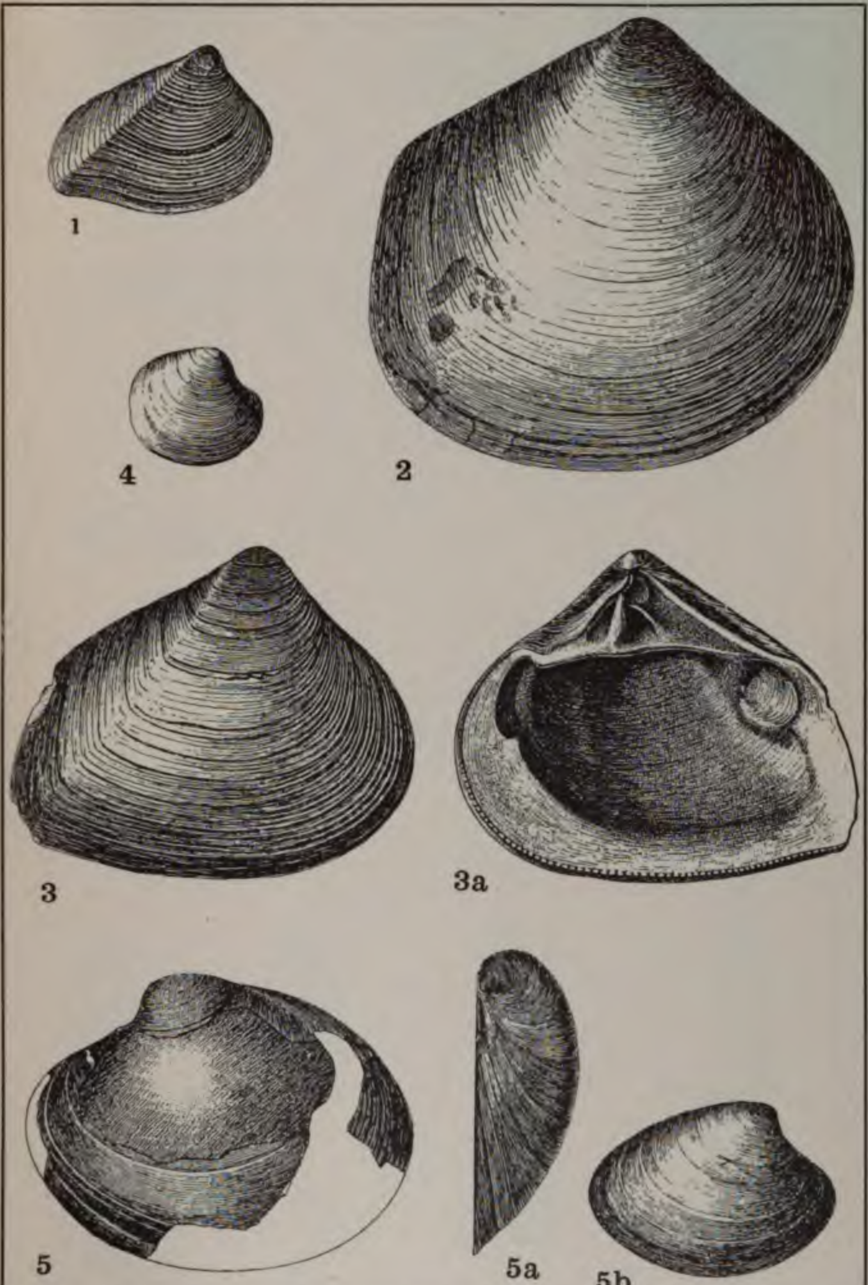

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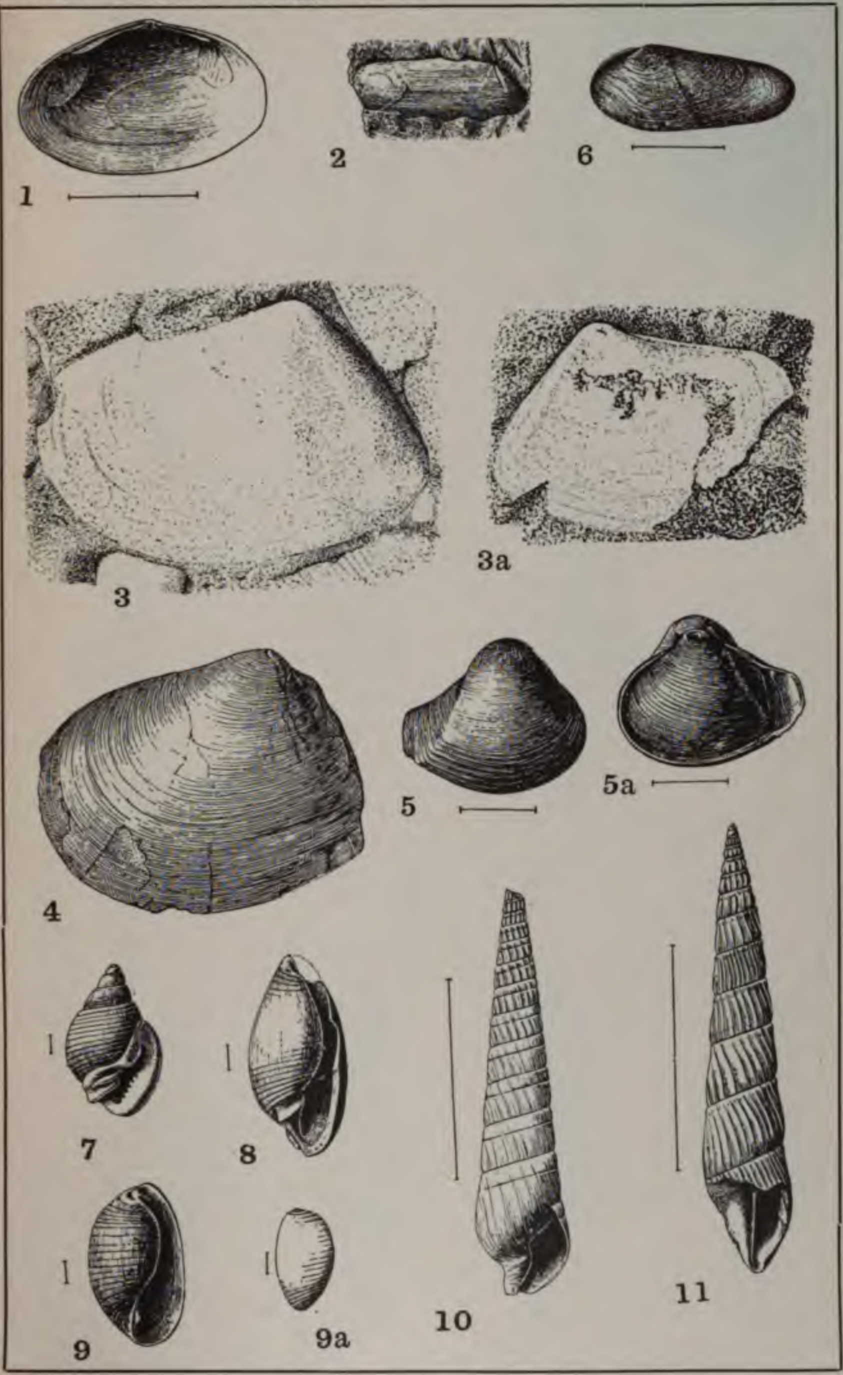

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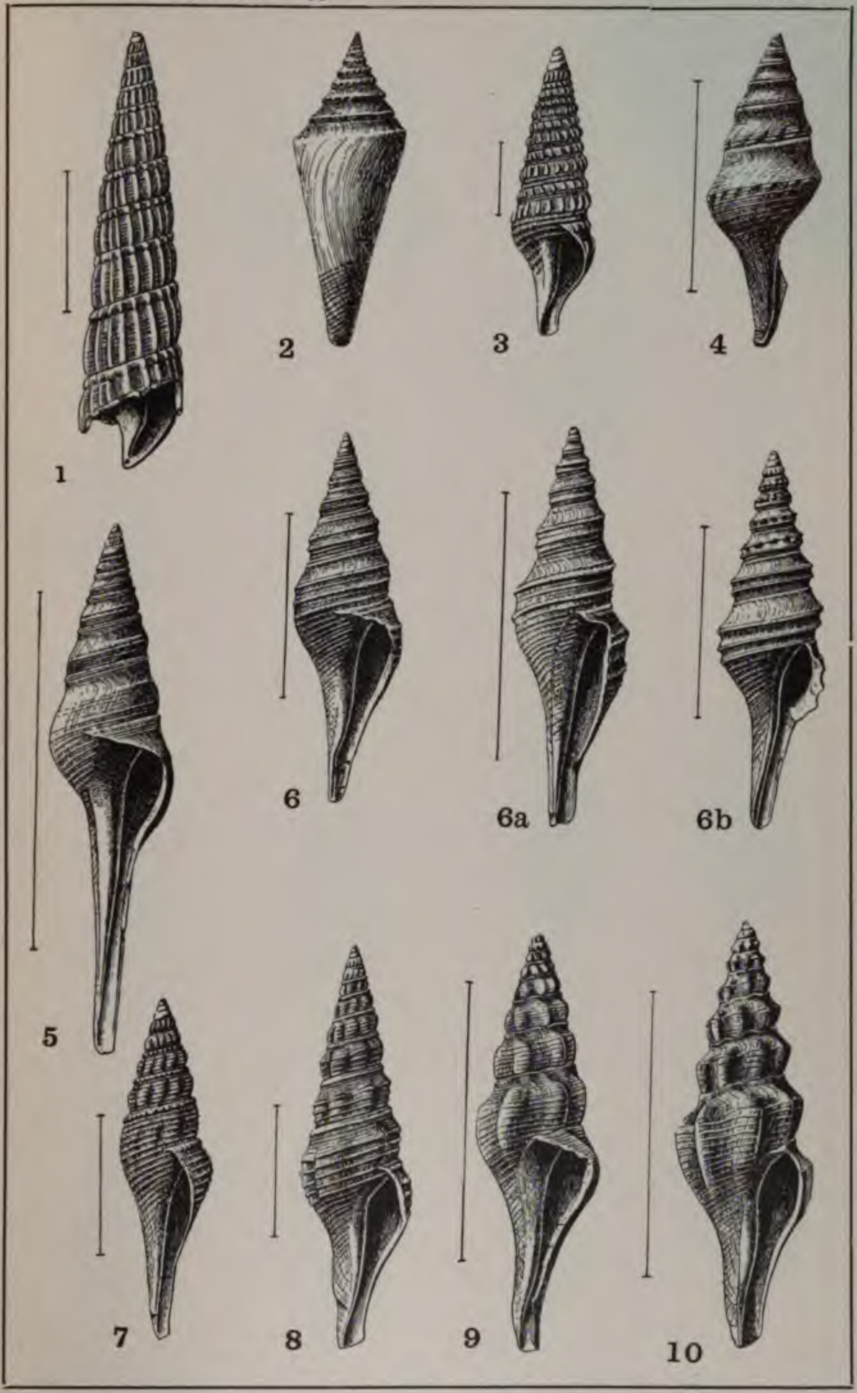

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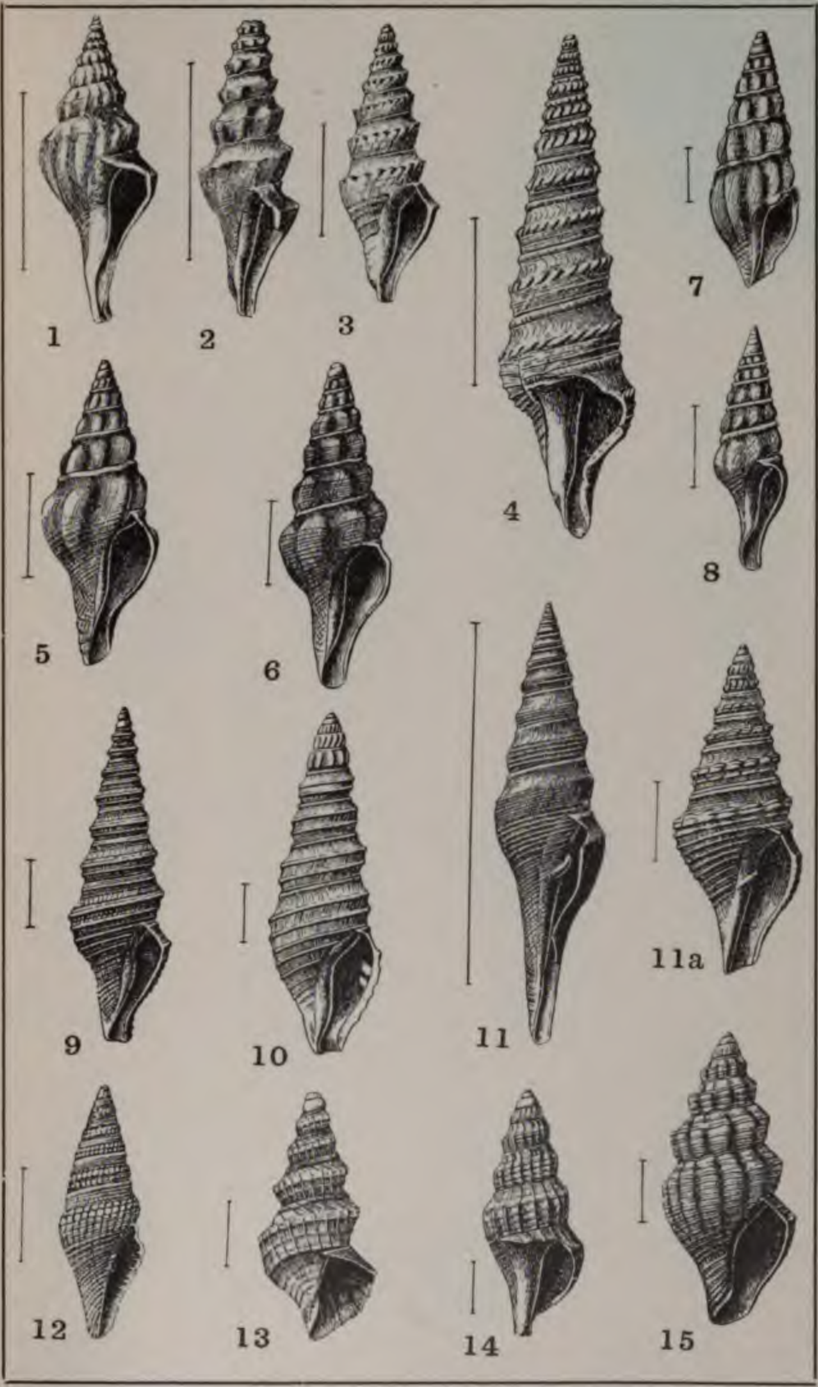

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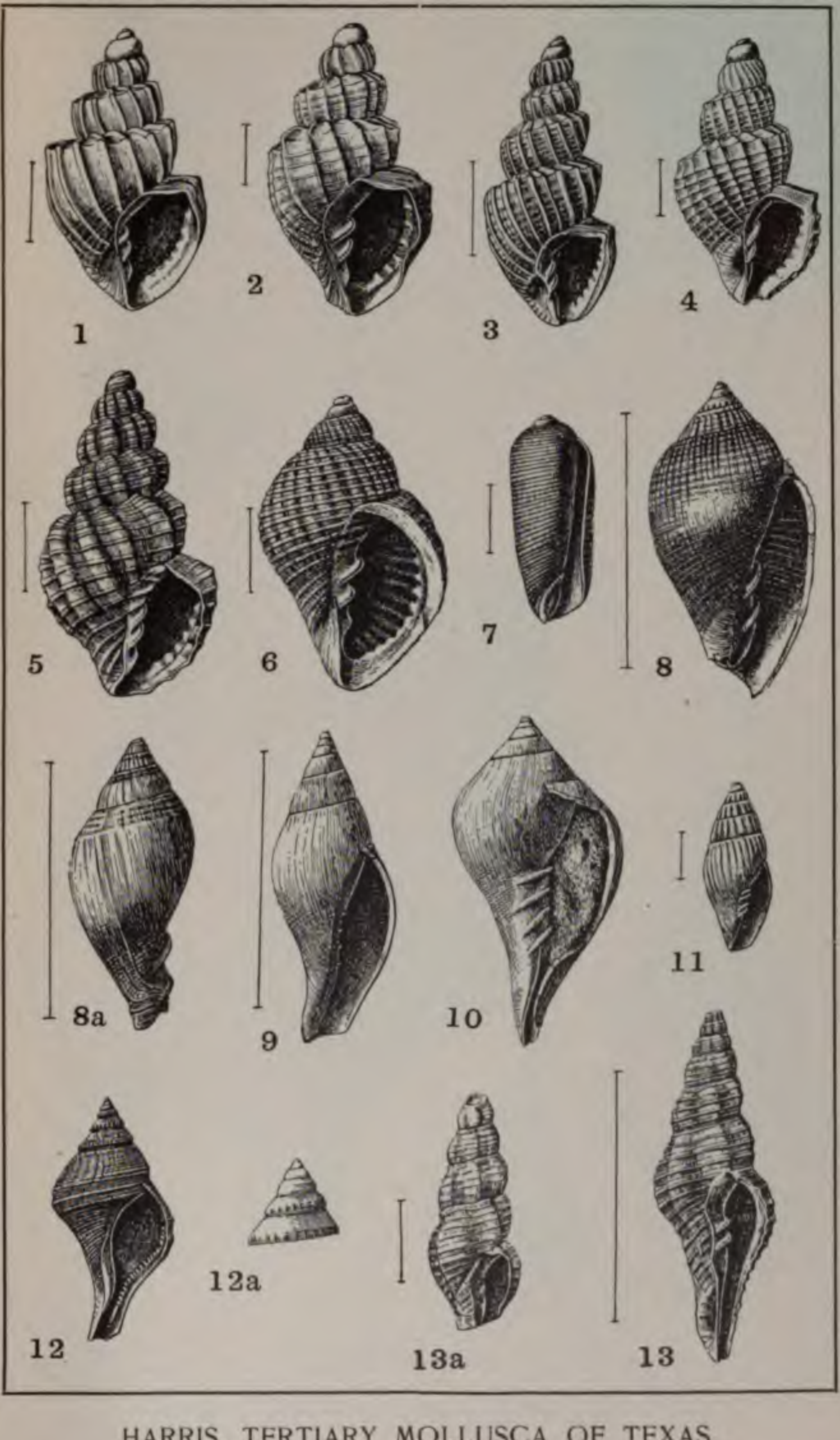

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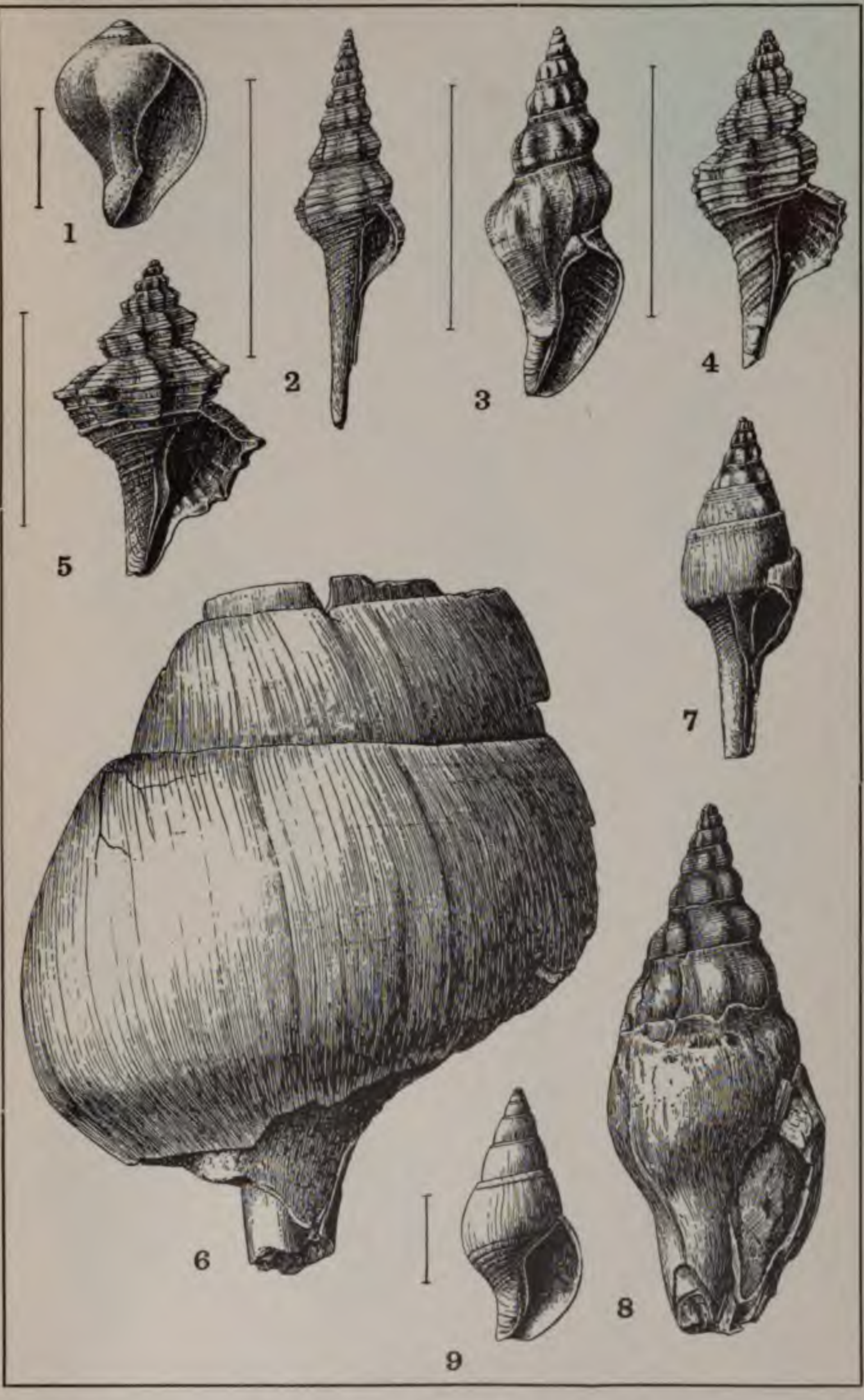

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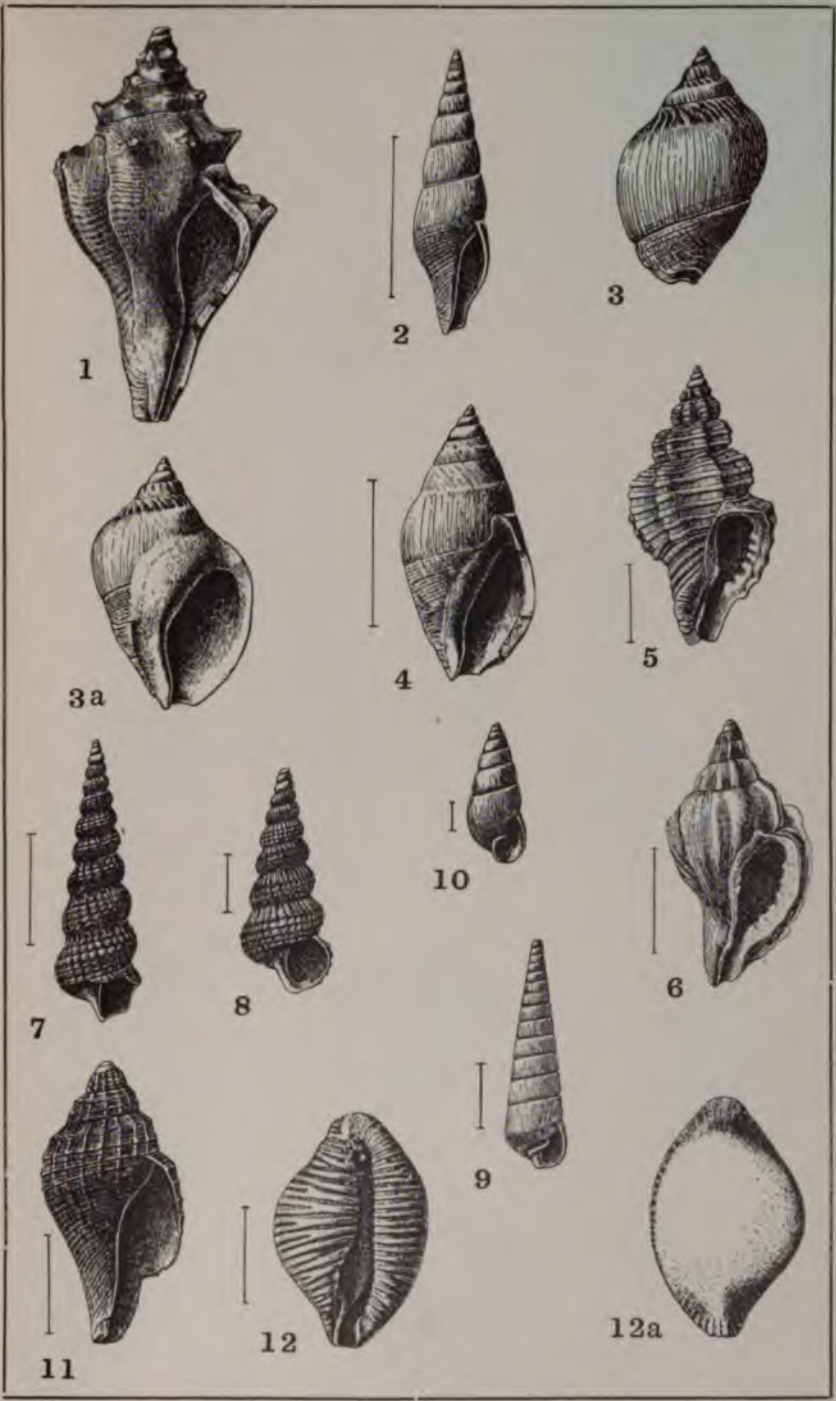

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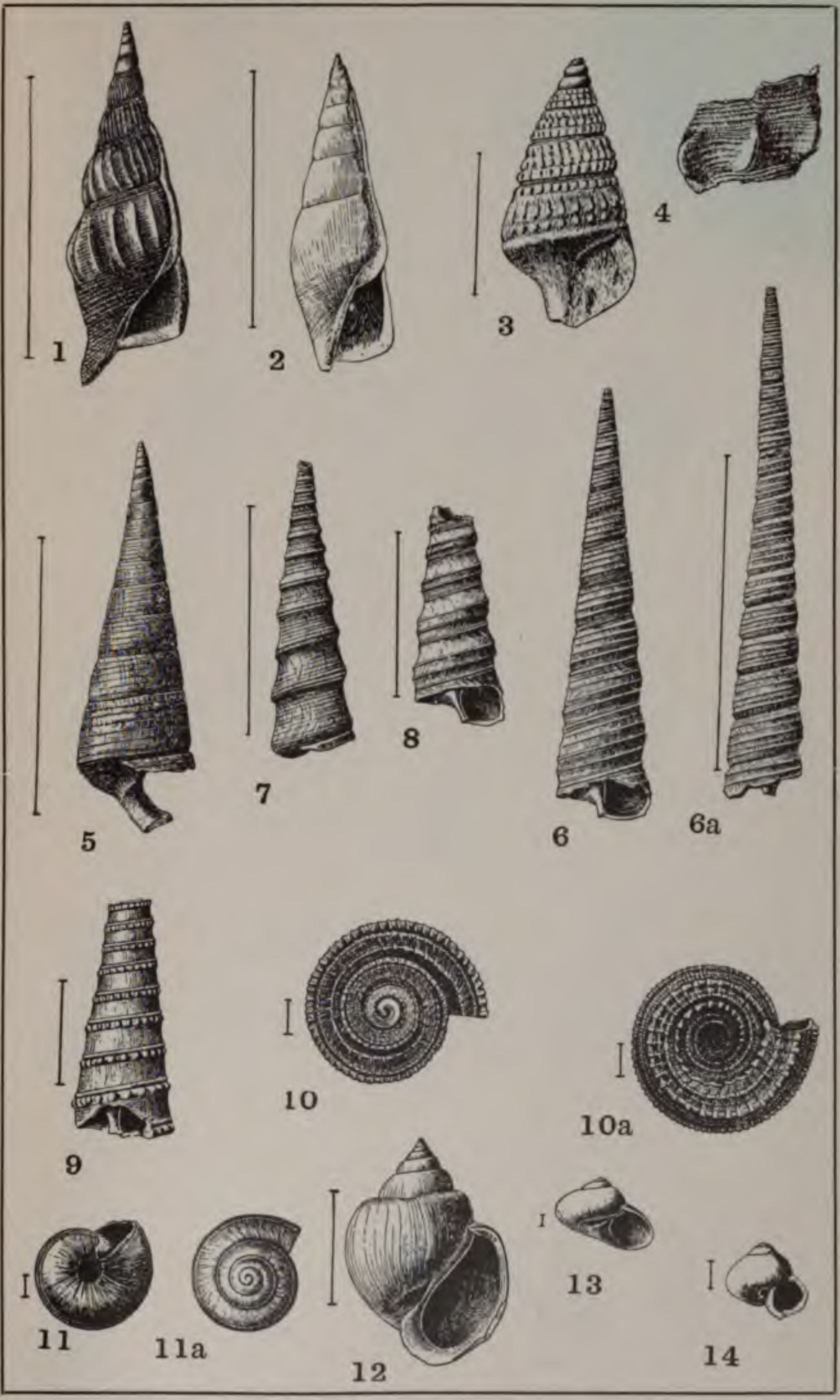

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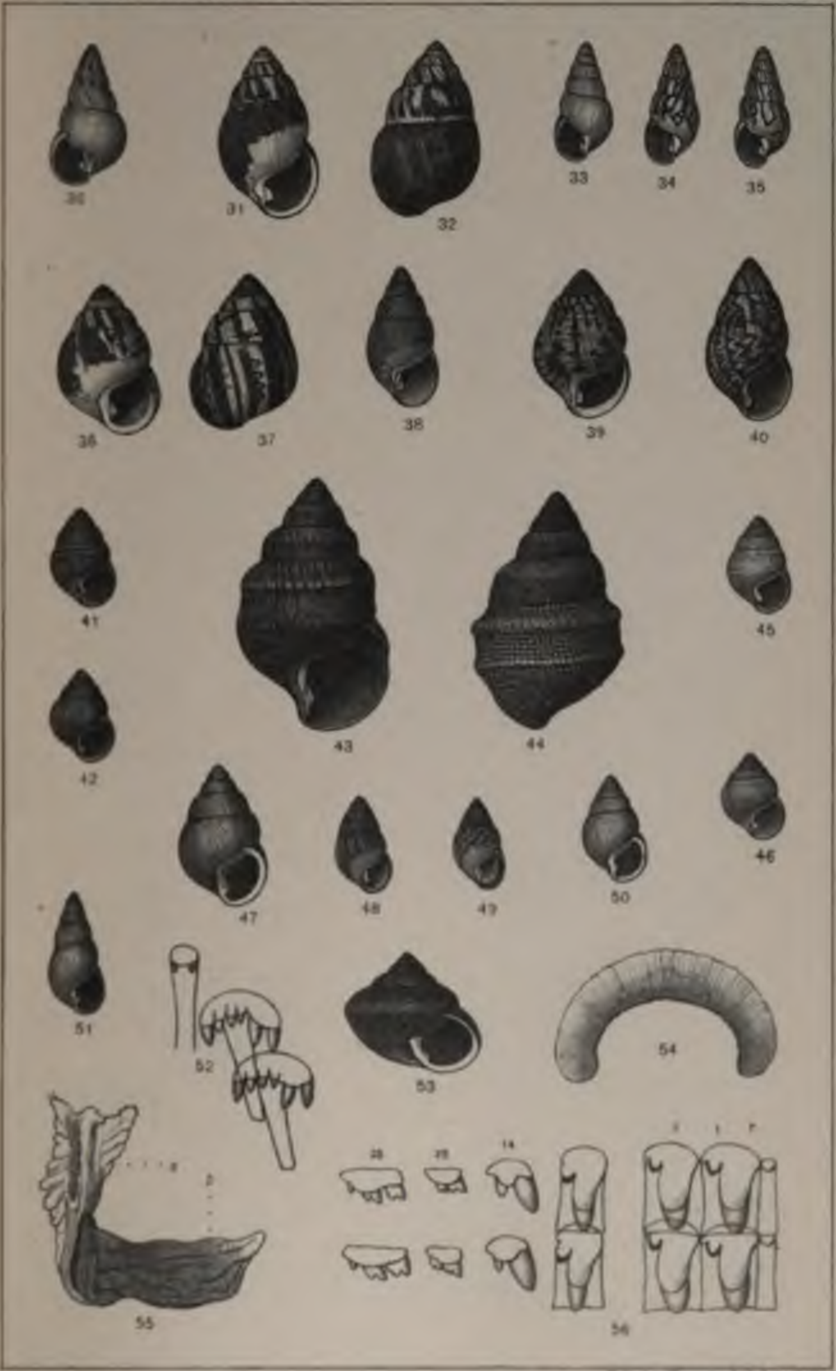

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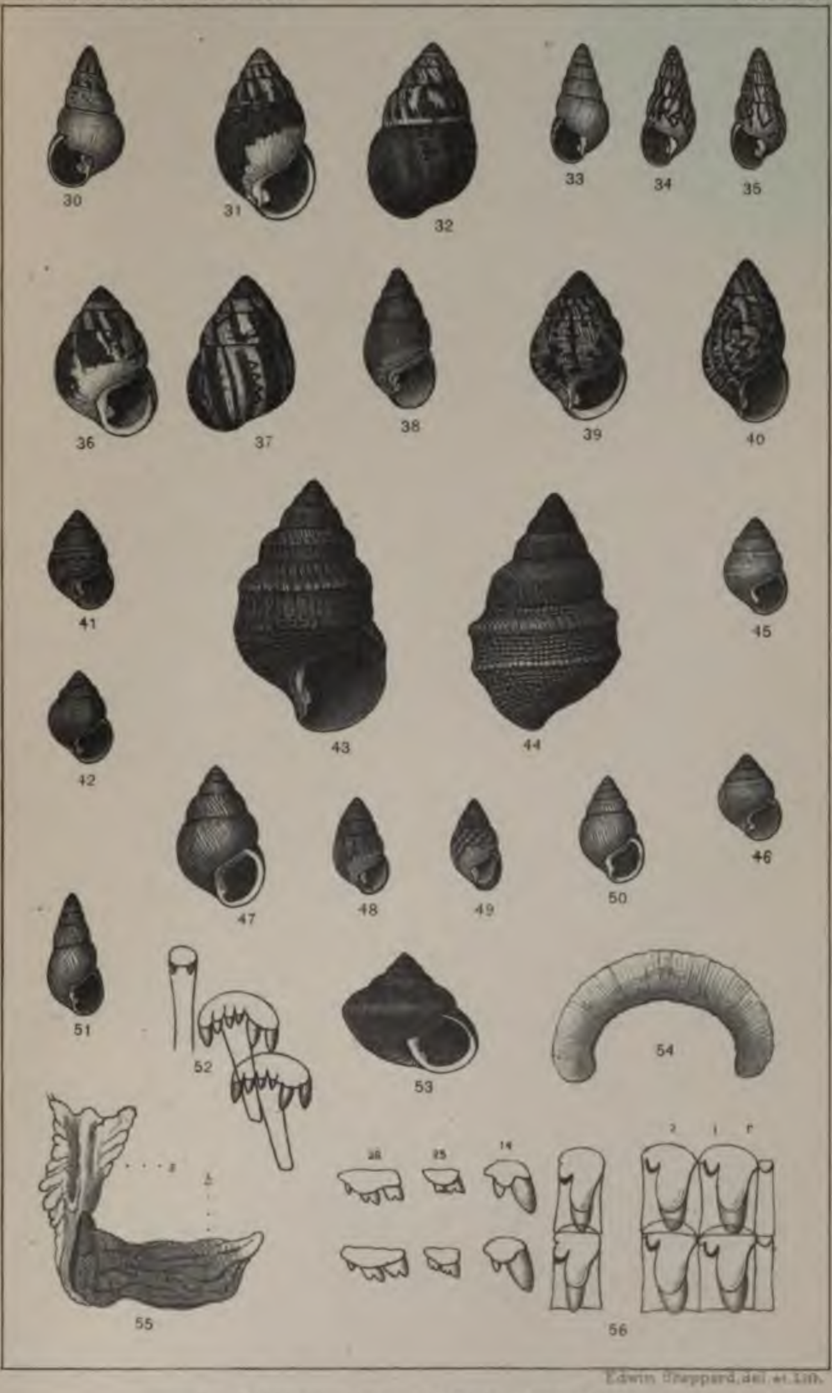

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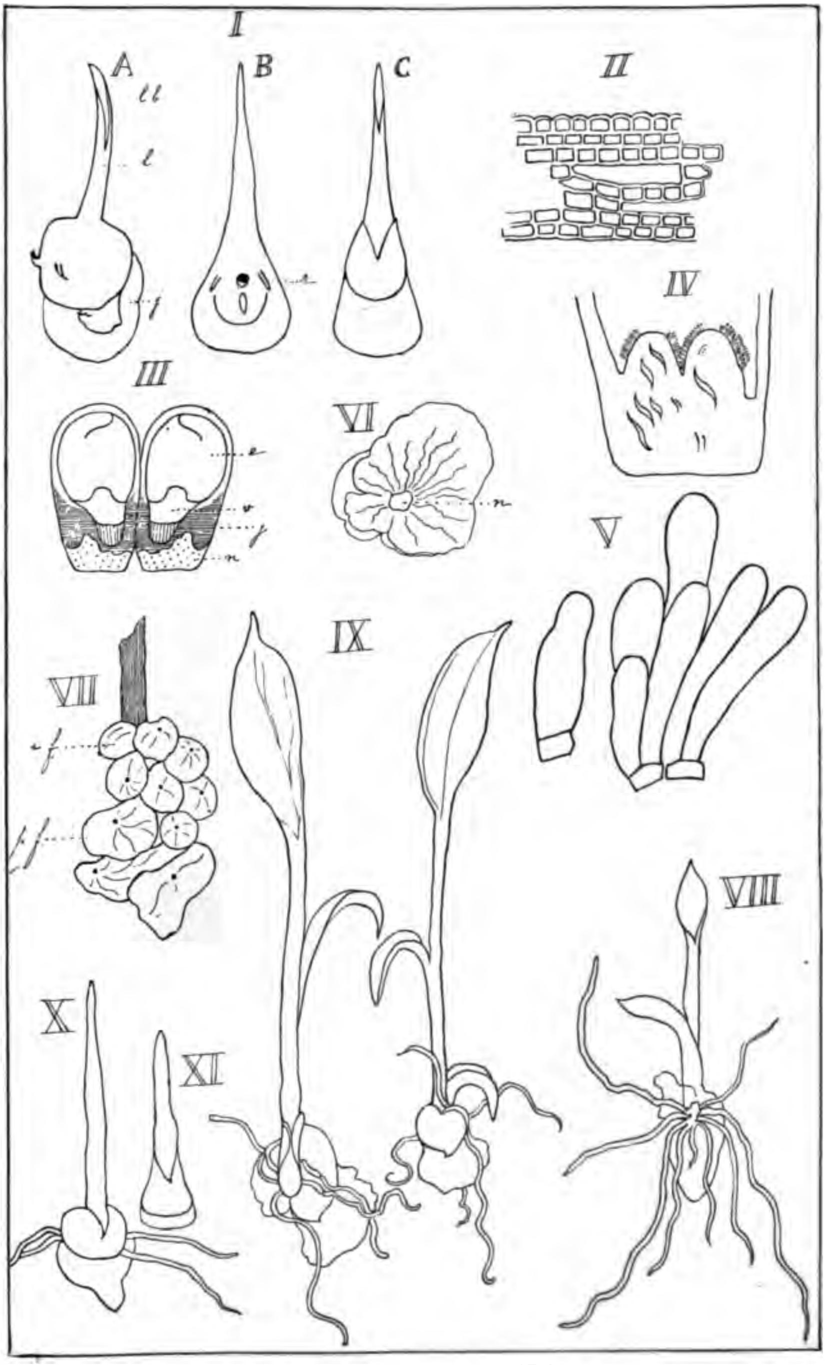

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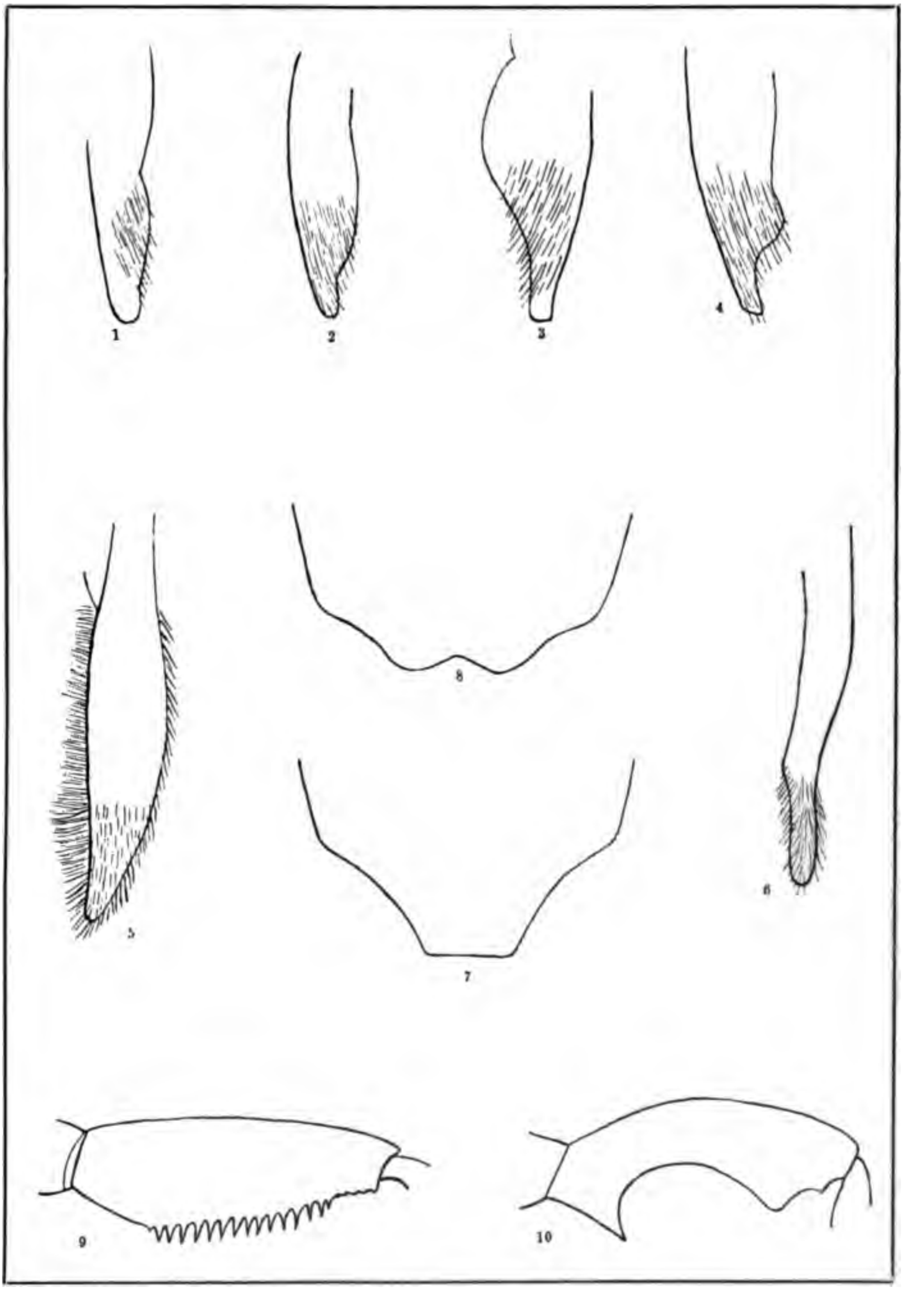

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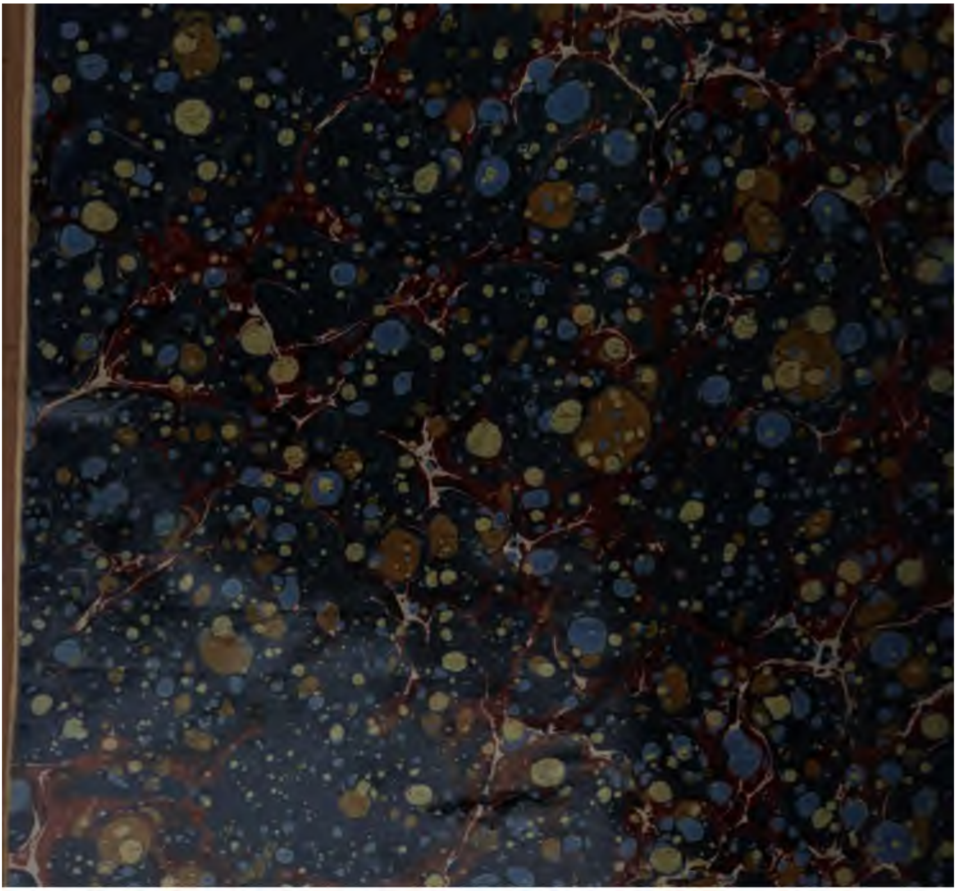

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